PRELIMINARY REPORT

A LAND AND WATER RESOURCE POLICY

for

THE UNITED STATES
DEPARTMENT OF AGRICULTURE

Prepared by

The Land and Water Policy Committee

UNITED STATES DEPARTMENT OF AGRICULTURE

Washington, D. C.

January 1962

UNITED STATES DEPARTMENT OF AGRICULTURE
OFFICE OF THE SECRETARY
Washington 25, D.C.

January 8, 1962

To The Secretary

From: George A. Selke, Chairman, The USDA
Land and Water Policy Committee

Subject: Preliminary Report - A Land and Water Resources Policy for the United States Department of Agriculture

This is the preliminary report, A Land and Water Policy for the United States Department of Agriculture, authorized in your Memorandum No. 1464, August 24, 1961.

In our analysis, we have been guided by comprehensive long-range goals and basic principles for the use, conservation, and development of land and water resources. Our proposals reflect the expectation of full participation by the people affected in the formulation and administration of policies and programs. These programs would be developed and carried out through the combined efforts of State and Federal governments.

Using 1980 as a target year, we have studied available data on population growth, economic activity, technology, yields, imports and exports, and the requirements of all the various uses competing for land and water resources. Our review indicates that of the 2,271 million acres in the United States about 640 million acres in land capability classes I, II, and III are suitable for regular cultivation, of which about three-fifths is cropped. In addition, about 170 million acres in land capability class IV is suitable for limited or occasional cultivation with intensive conservation treatment. Approximately one-fourth of this land is cropped. About 25 million acres being used as cropland is unsuited for cultivation.

Our analysis indicates the following projected requirements in 1980 compared with the land use pattern in 1959.

	1959	1980
	Million acres	Million acres
Cropland	458	407
Grassland	633	652
Forest land	746	741
Farmsteads	10	10
Total agricultural	1,847	1,810
Special use areas	147	195
Miscellaneous lands	277	266
Total nonagricultural	424	461
TOTAL LAND AREA	2,271	2,271

The study indicates that we could meet food and fiber requirements in 1980 with about 407 million acres of cropland. The cropland that would be used for crops is somewhat less than the acreage we are using now, despite the 53 million acres we had in various temporary land diversion programs in 1961. As a Nation, we are fortunate to have such a valuable land resource and we must manage its use to meet current adjustment problems and conserve its potential for future generations.

Agriculture is expected to continue as the predominant consumptive user of water well beyond 1980. The conservation and economic management of water in agricultural uses is critical for the balanced growth of all water-using industries and th entire economy.

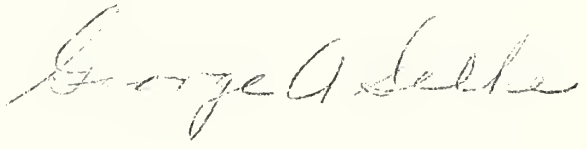
We have examined in detail the shifts between uses to bring about the best land use and to meet requirements. A program of research, education, and planning has been outlined to guide land and water use adjustments, conservation and development. In some cases, public programs to assist and facilitate land use adjustments have been proposed along with programs for conservation and development.

A major emphasis is placed on the encouragement of family-type farm, forest, and recreation enterprises.

We have outlined and recommended a land and water policy that would direct the Department's land and water activities toward the desired goal.

In some cases, program recommendations are advanced for immediate or pilot action; in other cases, suggestions are made with the purpose of stimulating further consideration and investigation. We urge a series of pilot programs accompanied by careful study and evaluation so that new program concepts may be tested, modified, and developed before full-scale operations are attempted.

The projections used in this report are based on a series of factors pertaining to population growth, exports, crop yields, resource utilization efficiencies, and other conditions that affect land and water resource requirements and potentials. The projections should be regarded primarily as reflecting likely directions of change rather than as precise expectations. Material variations in the plausible range of particular projections such as population, crop yields, and exports would significantly affect the calculated resource requirements.



UNITED STATES DEPARTMENT OF AGRICULTURE
OFFICE OF THE SECRETARY
WASHINGTON 25, D. C.

August 24, 1961

SECRETARY'S MEMORANDUM NO. 1464

U.S.D.A. Land and Water Policy Committee

1. LAND AND WATER RESOURCES PROBLEMS. The orderly development and use of the Nation's land and water resources in balance with national and regional needs pose problems of increasing public concern. Our present pattern of land use is seriously maladjusted. The abundance of our crop production has necessitated expanding land diversion and acreage reserve programs. At present 55 million acres of cropland are under diversion programs. We need to review relations between policies of land improvement and development on the one hand and land diversion and land adjustment on the other. A substantial area of land that is unsuited for cropping is being cultivated and should be shifted to noncrop uses. At the same time, additional land is being taken for highways, airports, industrial and urban uses, more land is desired for recreation and wildlife, and more forest land will be needed to meet future requirements.

2. POLICY AND PROGRAM NEEDS. There is urgent need for bringing the Department's best experience and knowledge to bear on the development and implementation of land use adjustment policies and programs that are designed to reflect the public interest and make the most effective use of our land and water resources. Systematic resource policies and plans, are essential for building better farm programs, making adequate provision for the conservation of resources and improving the well-being of farm people and of all citizens of the Nation.

3. ESTABLISHMENT OF LAND AND WATER POLICY COMMITTEE. To meet this need, I am establishing a U.S.D.A. Land and Water Policy Committee, with representatives from agencies most directly concerned. Members of this Committee are: *

George A. Selke, Sec., Chairman
Harry Steele, ERS, Co-Chairman
T. C. Byerly, ARS
Edward Crafts, FS
Floyd Higbee, FHA

(continued on reverse)

Carl Larson, ASCS
Charles Samenow, REA
Gladwin Young, SCS
E. T. York, Jr., FES
O. J. Scoville, SEG, Secretary

4. DUTIES OF THE COMMITTEE. The major purposes and functions of the Committee include:

a. Promoting and guiding Department-wide studies of production potentials and requirements for land, forest and water resources.

b. Formulating and recommending long-range goals and policy positions for the use, conservation and development of land, forest and water resources.

c. Upon request, recommending Departmental policy position on legislative proposals and on interdepartmental problems bearing on land, forest and water resources.

d. Appraising Departmental policies and suggesting guides to promote the application of consistent procedures by Departmental Services in planning and establishing resource improvement practices, projects and programs.

Establishment of this Committee does not alter any presently delegated responsibilities.

5. PRELIMINARY REPORT. As a first task, I am asking the Committee to prepare a preliminary report which will review the present and prospective land, forest and water resource situation, analyze its implications for Department policies, and give program recommendations.

Secretary

* Almon T. Mace, RAD has been appointed to the Committee.

CONTENTS

PART I

PRINCIPLES, POLICIES, AND PROGRAMS

This Part presents principles to guide specific policy and program decisions. Land and water use problems identified in the study are summarized. A land and water policy statement for the Department of Agriculture is presented with supporting explanations. A long-range program scheduled for application by 5-year periods is outlined for land-use adjustments, and for land and water conservation and development. The Part concludes with a discussion of basic surveys, research, and planning needs.

GUIDING PRINCIPLES

The land and water resources of the United States are vital national assets. How we conserve, develop, and manage these natural resources has an important effect on our economic growth, on the strength of our Nation, and on the long-run status of our Nation in world affairs.

A large part of these natural resources are privately owned and operated under provisions of the laws of the 50 States. The Department of Agriculture has the major responsibility for cooperative programs with the States to bring about the conservation, development, and management of soil, water, grass, forest, and wildlife habitat resources on private lands. These programs have included research, education, extension, technical, credit, and financial assistance. On the National Forests and National Grasslands, the Department is directly responsible for administration of a multipurpose program of resource management.

A major objective of a policy for land and water is that these basic resources serve all the people of the Nation. Those who depend on farming, ranching, and forestry should be assisted in assessing their needs and finding solutions to problems they cannot solve for themselves. Policy should assure to the Nation an abundant, desirable, and wholesome food supply; an adequate source of fiber and forest products and industrial raw materials; and assist in the conservation of the land, water, and forest resources.

Conservation involves the maintenance of the productive capacity of our land and water resources, and the development or improvement of productive potentials to the extent needed by future national requirements. The Department's goal is to devise land and water programs and supply management programs that will enhance farm income and achieve long- and short-run conservation objectives.

Since returns from private or public investment in land and water resource conservation or development occur over long periods of time, projections of future conditions are necessary in reaching current decisions. However, no one can foresee the future with great precision and statistical calculations of the Nation's future requirements and potentials can only indicate the probable direction of change. Estimates of the magnitude of future change cannot have a high degree of accuracy.

Decisions arising from present public action and the individual choices now being made by millions of individual landowners regarding resource use often preclude future choices. Sometimes

it is physically possible to reverse decisions, but it may not be economically feasible. The range of reversible economic decisions is much narrower than the range of physical possibilities.

The concept of nonreversible decisions can be applied to institutional arrangements also. Through institutional arrangements, vested rights or priorities may be created which virtually preclude future choices desirable from an economic or social viewpoint.

Recognizing the long-run and complex nature of decisions regarding land and water use, it is desirable to state some principles to guide specific policy and program decisions:

Policy should be comprehensive--for the Nation, for all regions, for all its land and water resources, and for all resource users.

The people who will be directly affected by the policies and programs should have ample and continuing opportunity to participate in the formulation of policies and to cooperate in the operation of programs.

The combined powers and efforts of the State and Federal governments should be employed in carrying out policies and programs with minimized restrictions on freedom of individual decisions.

Land and water resources should be efficiently combined with other resources so that the goods and services produced will provide maximum satisfaction, with account taken of both future and present needs and uses of resources.

The public programs should maximize the benefits from funds available for investment in land and water conservation and development.

Costs of land and water conservation should be borne in direct relation to the sharing of the benefits insofar as possible.

Land and water development programs should contribute to regional and national economic growth.

The program should be flexible enough to respond to changing needs and to provide reserves for unforeseen conditions, yet specific enough to achieve immediate land-use objectives.

The policies should be formulated and programs managed to achieve widespread benefits to farm people and others dependent on land and water resources.

The policies should recognize the Nation's limited supply of water and of land and should follow sound conservation principles and social value preferences in the use of these vital assets.

LAND AND WATER PROBLEMS

As described in Part II of this report, we have analyzed the use of our land and water resources, the land-use capability and potential productive capacity, and prospective future needs. We have also presented the trend in ownership and control of these resources and problems of use, efficiency, conservation, and management. Existing programs and policies are described in Part III of this report.

A projection of land use based on meeting estimated requirements in 1980 has been made (table 1). Our analysis shows that with appropriate research, planning, and action, our land and water resource needs over the next 20 years can be met. It will be possible to meet the increased demands for agricultural products in the next 20 years with 51 million fewer crop acres (table 1) than were available in 1959, providing the high rate of increase in application of technological improvements continues to be applied on productive land. This projection is based on an assumption that crop yields will continue to increase at a rate equal to the 1950-1961 trend.

In the course of our analysis, the following major problems were identified that need to be taken into account if we are to build better land and water policies and programs:

We can expect our farm production potential to continue to outrun effective demand for the foreseeable future. Long-range resource adjustment programs must be devised to maintain efficient production within the environment of production adjustments needed to meet effective demand.

We still have large acreages of unsuitable land devoted to crop production. More efficient use of resources and manpower will result from shifting such land to more suitable uses.

Some development and improvement of crop and pasturelands through irrigation, drainage, and flood control is expected to continue on the basis of justifications for developing family farms and for local and regional growth. These have been taken into account in projecting land-use requirements. A balance between such developments and total land-use adjustment activities will need to be taken into account.

Table 1.- Major uses of land in 1959 and projected uses to meet requirements in 1980 1/

Major use	1959 actual uses	1980 projection
	Million acres	Million acres
Agricultural:		
Cropland	458	407
Cropland harvested	(323)	(282)
Cropland pasture	(66)	(69)
Pasture	633	652
Forest land 2/	746	741
Commercial	(530)	(537)
Noncommercial	(216)	(204)
Farmsteads, farm roads	10	10
Total agricultural land	1,847	1,810
Nonagricultural:		
Special-purpose uses	147	195
Urban and other built-up areas	(54)	(74)
Areas limited primarily to recreation or wildlife use	(62)	(85)
Forest land 2/	(27)	(34)
Nonforest	(35)	(51)
Public installations and facilities	(31)	(36)
Miscellaneous land	277	266
Total nonagricultural land	424	461
Total land area	2,271	2,271

1/ Estimates are based on a 1980 population of 247 million and projected crop yields extrapolated linearly from the 1950-1961 trend. Further explanation may be found in Part II.

2/ The combined acreage of forest land in various related uses totals 773 million acres in 1959 and 775 million acres in 1980.

Our rapidly growing population will need greatly increased facilities for land and water based recreation. This growing population will also need increasing quantities of land and water for urban and industrial uses which at present are met in a haphazard and unplanned way. This is exemplified by the suburban sprawl, the encroachment on potential parklands and open space around our major cities, and increasing costs to acquire water for urban and industrial needs.

New employment opportunities will be needed to offset employment reductions that occur when land is taken out of agriculture. These new employment opportunities will provide some, but not all, of the jobs needed to support local communities and family farmers.

Local needs and plans, as well as national programs, should be accommodated in a well-developed and coordinated resource development program. We need to develop principles and procedures for the appropriate sharing of responsibility between various Federal, State, and local groups. Private, as well as public, roles in all aspects of resource use must be delineated and coordinated.

We need clear understanding of, and agreement upon, the relative advantages of different ways of changing land use, such as acreage allotments, quantity allotments, land rentals, easements, and land purchase.

A majority of small woodland owners are following poor forest practices in the management of their lands. The reasons why they are not following recommended practices should be more clearly understood so these growers can be encouraged to produce their necessary share of an increasing demand on our timber supplies. Suitable incentives to good management must be found.

Land and water problems are of increasing concern to both farm and nonfarm people. Public awareness of these problems and alternative solutions must be generated. The public must be kept informed of current and projected land and water requirements. This is to insure support for the implementation of carefully planned programs that will satisfy both rural and urban needs.

A RECOMMENDED LAND AND WATER POLICY FOR THE DEPARTMENT OF AGRICULTURE

The review of the Nation's land and water use situation, and trends and problems over the next two decades, together with the analysis of existing programs affecting land and water uses, has resulted in the following series of recommendations as to a desirable and far-reaching land and water policy:

1. The general objective of the Department of Agriculture should be to encourage land and water uses that will yield continuing maximum benefits to the people of the United States.

This involves the economical production in agriculture of foods and fibers in quantity and quality sufficient for human needs, to provide a satisfactorily high standard of living, to serve as a sound base for economic growth, and to enable the Nation to carry on foreign trade and assistance at effective levels.

The land, water, and forest resources of the Nation are assets vital to the continuing health, safety, and economic well-being of its citizens. National programs, through planning and coordination, should be directed at the conservation, development, and management of these resources to support a balanced and strong economy.

A large portion of the Nation's soil and water resources are privately owned and are operated under property laws and other laws of the 50 States. Therefore, the Department should continue to carry out its programs in cooperation with the States and their local subdivisions. These programs include research, planning, education, extension, technical assistance, credit, and financial aid.

Present and future programs should be designed and directed to ensure that conservation aims and balanced farm output are achieved while at the same time provision is made for improved farm income and opportunity.

The balancing of output with needs should be achieved through adjustment in land use in ways that will have the least adverse effect on farming efficiency and will make land and water available to an expanding population for living space, industry, commerce, and recreation.

In the conservation, use, and development of water as a resource, and in the conservation treatment of agricultural lands, the upstream watershed should be regarded as one of the most important bases upon which to plan and build for present and future needs of urban as well as rural residents.

On the National Forests and the National Grasslands the Department should continue to provide for, and ensure the administration of, a multipurpose program of resource conservation, development, and use.

The Department should continue to assist the people in agriculture with the problems they are not prepared to solve for themselves and through them to assure the Nation of a dependably abundant, desirable, and wholesome food supply and of an adequate source of fiber and forest products and materials for industry. This will require a vigorous, comprehensive program of research in land, water, plant, and wildlife conservation and development for the benefit of this and other countries. Effective programs are needed to ensure the timely application of research findings.

The foregoing steps will help the Nation to achieve widespread and equitable distribution of farm, forest, and recreation income through a system of owner-operated family farms, forest holdings, and recreation enterprises; to keep crop production in balance with domestic and export requirements; and to promote and accomplish the conservation and multiple use of land and water resources for both agricultural and nonagricultural development.

2. Adequate income for farmers should be an immediate and continuing objective.

Through its several programs, the Department should seek to enhance the opportunity for the farmer to produce an income from farming that will give him parity with other industries in the return on his investment and his labor.

The efforts at supply management and price and income support should be consistent with long-run land-use adjustments and with land and water conservation. Land-use programs should, of course, be consistent with income objectives.

Cost-sharing and technical assistance, as well as reasonable compensation for needed shifts in land use, should be available to farmers cooperating in the supply management and conservation treatment programs.

The Department should give special attention to the development of new uses and sources of income such as the recreational uses of land, water, forest, and wildlife resources, in ways that will contribute to the economic stability of family farming units.

3. The conservation of land and water resources should be carried on as one of the urgent and continuing needs of American agriculture.

The systematic use of proven soil, water, range, forest, and wildlife habitat conservation techniques should be encouraged to avoid costly erosion of soil, to protect and develop land resources for future uses, to manage soil and plant resources for efficient and continuing production of foods and fibers for human needs, and to permit the protection and improvement of watersheds and water resources for both agricultural and urban uses.

Since demand and production in the future cannot be foreseen with certainty, land, water, and forestry programs should be directed to permit flexibility in future uses. Under extensively managed grass, and to a more limited extent under tree cover, soil resources not now needed for cultivated crops should be kept stable and available.

Department land and water programs should proceed according to the scientifically proven principles of good land use based on soil surveys. These programs should be designed to achieve needed treatment of eroded and depleted soils; protect land against erosion and other deterioration; protect and improve forests, farm woodlands, and grasslands; conserve moisture for agricultural use; reduce flood and sediment damage; improve the quality and dependability of water yields; apply conservation techniques in the management of water; and increase overall farming efficiency. Complete conservation treatment of agricultural lands should be encouraged through technical assistance, credit, and the sharing with the farmer of treatment costs.

The protection and development of entire small watersheds, fitting together the management of crop, range, and forest lands, and the treatment of watercourses to minimize flood damages and sediment yields, to encourage the movement of water into the soil for plant use, and to improve the quality and dependability of water supplies for urban as well as agricultural users, should be a continuing objective. The enterprise, judgment, and leadership available in communities involved should continue to be utilized in the planning and execution of individual projects.

In the areas of the Nation that have the more serious land-use problems and greater agricultural hazards, special provision for land adjustment, for research, for the conservation treatment of land, for education and demonstration, for credit, and for measures to achieve steady economic growth should be encouraged.

Programs involving the conservation, use, and treatment of land and water resources and the making of needed adjustments should take into account the problems of people who use the land to earn a livelihood and who must receive an equitable return as they strive to meet consumer needs.

4. Widespread and equitable distribution of farm, forest, and recreation resource ownership and income should be induced through encouragement of owner-operated family farms, forest holdings, and recreation enterprises.

This objective is based on the concept that a system of family farms will make a major contribution to a healthy and vigorous national economy. The farmer, too often the victim of conditions and hazards of climate and of price declines beyond his control, is an important factor in the overall economic structure. His economic well-being as a citizen, as a producer, and as a customer and user of a large portion of the national product, merits reasonable provision for safeguard. The historic objectives of a family farm system of agriculture are as valid today as they were during the settlement of this country over 100 years ago. We consider a family farm to be one for which the operating family furnishes the bulk of the labor required.

It should be the policy of the Department of Agriculture to assure the largest feasible number of efficient family-type enterprises, first, by developing management, production, and marketing techniques designed for the family enterprise; second, to make available other assistance in the form of credit and financial assistance as may be needed to keep family farming businesses in healthy condition with returns adequate for the needs of the family; and, third, to provide ownership credit so that qualified farm youth without adequate financial resources may have access to farm ownership. The Department should also administer its other programs to promote the family farm and should explore with State authorities the possibilities of strengthening family farms through appropriate institutional and educational devices.

5. The Department should offer guidance to the type of land use and the pattern of rural residence to ensure adequate community improvement, expansion, and development.

Major land-use changes accompanying the Nation's shift from a rural to an urban economy are creating new, and compounding existing, social and land-use problems. The press for new living space often may result in efforts to put some lands into uses for which they are poorly suited. Land-use shifts from crops to grass and trees, and shifts to urban, industrial, transportation, and other nonfarm uses will create many community problems.

The Department of Agriculture has major interest in, and responsibility for, offering guidance and help in obtaining sound use of land and water resources and patterns of rural residence that will facilitate provision of community, educational, health, and other services.

The Department, therefore, should increase its efforts to provide and, where needed, to expand its activities in furnishing technical information on soils, water, and land uses to State or local organizations responsible for community planning and development.

This service should include: (a) The provision of accurate information on soils showing their suitability for use for specific purposes, including high-value agricultural use; (b) assistance to State and local planning groups in interpreting information on soils as a guide in sound development; (c) assistance to local governments and other organizations to understand opportunities and limitations in the watershed protection and flood prevention program; (d) guidance to Federal and State agencies on land and water use planning, land management, rural zoning, and other means to prevent future, or eliminate present, occupancy of lands creating problems involving health, safety, or high-cost services; (e) technical assistance to owners of rural land being used for agricultural or nonagricultural purposes to make needed adjustments and achieve proper use and treatment; and, (f) cooperation with other Federal departments to achieve proper use or development of all lands with particular accent on their suitability for agricultural use.

6. Improve efficiency of farming, ranching, forestry, and recreation by continued improvement and adaptation of technology to family-type operations through research, extension, technical and financial assistance, and credit.

In a world of technological revolution, the most advanced technical processes must be adapted to the family farm unit if that type unit is to survive. This is an objective of basic and applied research on agricultural technology. The Department should direct its production research efforts to the continued improvement and adaptation of technology to family-type enterprises. Technology must be adapted to make man more efficient--not man adapted to serve technology. Extension, technical, and financial assistance, and credit should be used to stimulate the application of research results on the family farm.

A balance between supply of farm products and needs should be sought through the systematic application of the principle of the use of land within its capability and through the diverting of land from production of crops beyond present needs.

Land diverted from use in crops should be given conservation treatment according to its needs and capability classification.

Increasing efficiency in the family-type farming operation can be expected to result in lower unit costs of production. Practices to be emphasized should include those which will maintain high soil productivity and high efficiency in soil-plant-water relationships, make use of improved plant varieties, and provide for protection against diseases, insects, and weeds. Farming practices known to have a harmful effect on the capacity of soils for sustained efficient production should be discouraged.

Opportunities in forestry in a family farming enterprise, especially on units where soil surveys show the land to be best suited to this use, should be encouraged. Development of recreation and wildlife resources as a phase of family farm operation should be stressed where appropriate.

This Department should strengthen its programs to improve management and technologies adapted to family-type operations. The Department should continue to provide educational opportunities, and technical, credit, and financial assistance for this purpose.

The flood plains of small watersheds represent one of the opportunities for protection, improvement, and diversification of farm enterprises. Such lands, because of flood threats and erosion, are seldom used to the limit of their potential for crops or other purposes. With the more efficient and varied uses of these acreages as objectives, and with other important advantages accruing to rural communities from watershed projects, the Department program of watershed protection and flood prevention should be pressed. Such an effort should be used to adjust and stabilize the economies of family farms and of communities. A broadened watershed program including forestry, recreation, and wildlife management will accomplish much toward obtaining needed balance and efficiency in use of these flood plain areas.

As with flood plains, the development of wetlands will be considered under a broad program including farming, forestry, recreation, and wildlife management. Technical, financial, and credit assistance should be made available to family-type enterprises when wetland improvements will result in a more adequate farm base and family income. In this program, all values of the land for current and future uses should be carefully weighed.

7. Improve efficiency of water use and promote water conservation by finding improved practices of soil and water management and by adjusting institutional arrangements to promote efficiency and avoid waste.

As one of the largest users of water, agriculture has a responsibility for its conservation, its efficient use, and for avoiding waste. Many studies show that the efficiency of agricultural water use could be greatly improved, yet trends of the last decade indicate that little improvement has been achieved.

The Department should encourage the application of present knowledge and undertake an expanded program of cooperative research on problems of the agricultural uses of water and the institutions affecting water use. Based on such studies, States should be encouraged to adopt equitable water-use laws that clarify rights to use water resources and promote optimum use. Further development of water resources should recognize present rights of water users. As uses of land are changed to fit altered conditions and meet new needs, water requirements can be expected to change. Adjustments in State water laws and administration of the laws should be considered to meet changing situations.

The National Forests and National Grasslands should be managed to increase the quantity and improve the quality of water received from such lands.

Technical and cost-share assistance and credit should be supplied to enable landowners to install practices that will promote conservation in water use on farmlands, and promote water yields of higher quantity and quality where these lands are in agriculturally important watersheds from which supplies for urban and other users are drawn.

8. In an intensive effort to reduce the harmful effects of water and air pollution, of soil contamination, and of the use of pesticides and herbicides, the Department should utilize its resources and facilities to increase protection, and seek remedy through research and application of improved technologies.

Dissolved salts, suspended sediment, and turbidity are among the principle impairments to water quality. Accumulation of salts and toxic materials in soils is one of the hazards of irrigated agriculture. Chemical solutes from unusually heavy fertilizer application on agricultural land may contribute to lower water quality. The leaching of accumulated salts in irrigated soils with water of low salt content may increase dissolved solids in return flow and thus aggravate water problems for other users.

Silt or sediment from eroding agricultural lands, deposited in reservoirs, stream channels, on flood plains, or in municipal areas, represents tremendous economic losses.

The pollution of air with gases, fumes, and solids in increasing amounts has definite agricultural implications. Evidence is mounting that certain of these pollutants are damaging to livestock, and to the quantity and quality of crops, including forest vegetation.

The greatly increased use of agricultural chemicals has been attended by certain problems involved in their safe use. Unless properly used, pesticides can create hazards through contaminating foods, by endangering livestock, game animals, fish, birds, pollinating insects, and beneficial parasites and predators, and by affecting the soil and plants grown in the soil.

In the search for solutions to all of these problems, agriculture shares responsibility. In the problems of air and water pollution, the control of sedimentation damages, and the harmful effects of certain agricultural chemicals, steps should be taken rapidly to identify hazards, establish safeguards, and develop improved technologies.

The Department should cooperate with other departments, public agencies, and with State and local groups to find needed solutions to these problems.

9. The Department should cooperate with State and local agencies in making available technical services and information to guide land and water use where urban expansion is occurring.

Information gathered through soil surveys on the suitability of certain soils for various uses related to urban development should be made available to persons concerned with urban expansion programs as well as those involved with agricultural uses of land resources.

The planning of "open space" or areas of recreational use, within easy access of urban centers should be thoroughly weighed as the values of land and water resources in various uses are considered.

In any conversion of agricultural land to urban and related uses, the Department should discourage uses and practices which would invite erosion and high maintenance costs. Developers, builders, and planning agencies should be encouraged to make use of information available through soil surveys on soil conditions affecting the conversion of lands to urban uses.

Department representatives should cooperate with State and local authorities and make available the services of specialists in dealing with individual and community problems growing out of the changing uses of land and water resources.

Planning and development on a watershed basis should be encouraged as a means through which realization of optimum benefits from soil, water, forest, grass, and wildlife conservation may be achieved for both rural and urban residents.

10. The Department should provide landowners with technical and financial assistance to develop, maintain, and improve the habitat for fish and wildlife on their lands and to develop recreational enterprises.

The Nation's privately held lands, because of extent and variety, hold a major potential for meeting the wildlife conservation and production needs of the Nation. These private landowners are the principal custodians of the Nation's wildlife habitat. Incentives should be provided for them to manage their lands to preserve and increase wildlife populations for recreational and other uses.

Cost-sharing and credit as needed should be made available for such practices as construction of fish ponds, for the planting of vegetation for game food and shelter, and for protection of this environment.

The Department should offer technical assistance to States or local agencies in the development of rural lands to supplement present acreages of public parks, State forests, game management areas, and public hunting grounds.

11. In formulating programs implementing land and water policy, the Department should utilize all of its resources and authorities to assure optimum opportunities for human resources in rural areas.

It is recognized that land and water resources are meaningful only in relation to their use by people. As adjustments in land and water use occur, the Department should continue to utilize its resources and authorities to facilitate human adjustments.

Land- and water-use adjustments should be such as to maximize the opportunities for full employment by families remaining on rural land. This will require technical and financial assistance to farm families to help them make necessary adjustments in the size or nature of their operations to achieve adequate family income. Greater emphasis should be given to enhanced income opportunities in forestry and in recreational enterprises. Means for increasing nonfarm employment for the improvement of living standards in rural areas should be sought and assistance given in their development.

Credit for adequate housing, domestic water supply, recreation facilities, and electrification and communications services should be provided to encourage desirable patterns of rural living and to stimulate rural commerce and industry.

12. Greater emphasis should be placed on education action and on planning at local, State, and National levels to provide for the conservation and wise use of land and water resources.

Satisfying the growing need for multiple use of land and water resources requires cooperation by all interests. All persons concerned must be kept aware of the importance of maintaining proper balance between present and future needs.

Plans and programs should be directed at focusing the attention of local citizens especially upon the full range of solutions and adjustments. Single programs should be coordinated and related to overall opportunities and requirements. Local citizens should be encouraged to participate fully in the planning and implementation of action programs.

Strong local organizations should be promoted to facilitate participation by the local citizens who will be directly affected by changes in land- and water-use patterns. Without special effort at local organization and participation these groups may remain unmindful of changing national conditions and of opportunities to adjust to future needs through timely community action. National programs should be integrated with local community plans, and local plans should reflect National needs and goals.

A LAND AND WATER PROGRAM

This section outlines land-use adjustments likely to be needed over the next 20 years to meet agricultural and nonagricultural requirements for land and water resources. Desirable rates of adjustments and proposed measures to contribute to such adjustments are set forth in general terms. Included also is a recommended long-term program of conservation and development, including measures to make farming and other employment opportunities available in rural areas. The necessary basic surveys, research, planning, legislation, and organizational arrangements would be worked out with cooperating Federal, State, and local organizations.

Projected Land-Use Adjustments

In the 50 States, 458 million acres were used as cropland in 1959. Requirements of cropland for 1980 are calculated at about 407 million acres. This reduced amount of cropland is calculated to be adequate to meet export needs and provide an upgraded diet for 247 million people by 1980. This is an increase of approximately 40 percent in farm output requirements for food and fiber for 1980 as compared with 1959. Crop yields during the past 12 years have increased at an average annual rate of 2.5 percent. This trend in crop yields was projected to obtain the estimate of crop production per acre in 1980.

There is a potential of 640 million acres of cropland (classes I, II, and III) in the United States and another 170 million acres that might be used for limited or occasional cultivation at high cost and with intensive conservation treatment (class IV). Thus, sufficient productive land is available to meet the needs for food, for fiber, and for the nonagricultural requirements of an expanding population, with continued advances in technology and continued efficient use of land and water.

Calculated needs for food and fiber in the next 20 years can be met with a net reduction in cropland of about 51 million acres (table 2). Utilization of this acreage will allow us to partially meet the expanding needs for forests, recreation, wildlife, urban, and industrial uses.

Since a projection of future needs cannot have a high degree of accuracy, provision for adequate cropland reserves is an essential part of the Nation's land policy. As a Nation, we are fortunate to have such a large cropland potential. It is a valuable national asset which should be conserved for the future.

Table 2.- Projected land-use adjustments

(Million acres)

Change	20-year projection	First 5-years	Second 5-years	Third 5-years	Fourth 5-years
Cropland:					
To urban	5.0	1.2	1.2	1.3	1.3
To public facilities	1.0	.3	.3	.2	.2
To recreation, open space, wildlife	5.0	2.0	2.0	.5	.5
To pasture	38.0	25.0	7.0	3.0	3.0
To forest	19.0	6.5	6.5	3.0	3.0
Total	68.0	35.0	17.0	8.0	8.0
Pastureland:					
To cropland	10.0	.5	.5	3.0	6.0
To urban	5.0	1.2	1.2	1.3	1.3
To public facilities	1.0	.3	.3	.2	.2
To recreation, open space, wildlife	6.0	1.5	1.5	1.5	1.5
To forest	8.0	2.0	2.0	2.0	2.0
Total	30.0	5.5	5.5	8.0	11.0
Forest land:					
To cropland	7.0	.5	.5	2.0	4.0
To urban	5.0	1.2	1.2	1.3	1.3
To public facilities	2.0	.5	.5	.5	.5
To recreation, open space, wildlife	7.0	2.0	2.0	2.0	1.0
To pasture	11.0	2.5	2.5	3.0	3.0
Total	32.0	6.7	6.7	8.8	9.8
Miscellaneous:					
To urban	5.0	1.2	1.2	1.3	1.3
To public facilities	1.0	.2	.2	.3	.3
To recreation, open space, wildlife	5.0	1.3	1.3	1.2	1.2
Total	11.0	2.7	2.7	2.8	2.8

The 20-year projection of land-use changes (table 2) shows the adjustments needed to meet estimated requirements for crops and pasture, urban and public facility uses, and to aid in meeting demands for forest, recreation, open space, wildlife, and other projected uses. Many of these projected land-use shifts are related directly to population growth. Shifts to urban and industrial uses and to public facilities is mainly a problem of planning and guidance. Other shifts out of farm use to recreation and wildlife purposes will require public programs, in addition to planning and guidance, to bring about the adjustments. The shifts between crop, pasture, forest, and to nonfarm uses involve adjustments within farms and between farms, and also will require assistance of public programs.

In addition to these adjustments there is the problem of keeping potential cropland from being brought into use before it is needed.

In the proposed land-use adjustment to contribute to supply control efforts, a desirable goal for conversion of cropland to pasture, forest, and recreation and other uses would be 35 million acres in the first 5-year period. In the second 5-year period the goal would be to shift 17 million acres of cropland to other uses, while in the third and fourth 5-year periods the goal would be 8 million acres (table 2).

Some conversion of pasture and forest land to cropland will probably take place as individuals seek to increase their income. Encouragement should be given, however, to defer such conversions to the latter part of the 20-year period, when cropland will be more nearly in balance with requirements. As a goal, conversion to cropland should be held to 200,000 acres per year during the first five years. The goal proposed here for the first 5-year period is to retire 35 acres of cropland for each new acre of cropland added. In the second 5-year period the goal is to retire 17 acres of cropland for each new acre of cropland added. In the third and fourth 5-year periods as much cropland could be added as is retired.

Existing programs should be reviewed and changed as necessary to provide incentives to keep land use more nearly in balance with requirements. Exceptions would be made for assistance in enlarging inadequate family-type farms.

At the present time, 28.4 million acres are in the Conservation Reserve. Contracts will expire on 16.8 million acres in the next five years and on 11.6 million acres in the second five years. As contracts expire these lands will be eligible to participate in any Department of Agriculture land diversion program. There are about 600,000 cropland acres under contract that have been shifted

to grass in the Great Plains Conservation Program. Contracts in the Great Plains Conservation Program will expire on 300,000 acres in the next five years and on 300,000 acres in the second five years. These lands also will be eligible to participate in land diversion programs.

It is anticipated that land diversion programs for crop production control may be recommended for some major crops in the next few years. It is desirable that land now in the Conservation Reserve or Great Plains Programs not suitable for cropping should not be allowed to revert to crop production or remain eligible to participate in annual cropland diversion programs. In exchange for giving up the eligibility to participate in these programs, the owners should be compensated and allowed to put their land in some other use. Payments for long-term easements or total rentals for the period of a contract should not exceed the agricultural value of the land. Eventually, the annual cropland diversion programs should be phased into the permanent land-use adjustment program.

Programs are proposed in the following sections to convert cropland to grass or trees and to assist in developing recreation and wildlife uses. These would be voluntary programs. If a farmer having eligible land wanted to cooperate he could apply for participation in the program which best met his circumstances.

Long-Run Adjustment of Cropland to Grass

Under this proposed program, cropland, including part of the lands now under the Conservation Reserve and Great Plains Programs, would be converted to or kept in grass. The purpose would be to return poorer cropland to permanent grass cover and to place some of the better land in a grassland reserve. In its early phases, the program would give primary attention to lands that will be coming out of the Conservation Reserve, although it would be offered on all eligible lands.

The procedure would be as follows:

1. Examine expiring Conservation Reserve contracts or applications from other farmers wishing to participate in such a cropland conversion program and separate the land into two categories based on soils and other factors.

   Category A. Land classed as poorly adapted to cropping.

   Category B. Land classed as suitable for continued cropping which, for production adjustment purposes, should be kept in a grassland reserve until needed.

2. For category A (permanent grassland) offer the owner of the land a lump sum payment for a long-term easement to discontinue cropping but to allow the land to be used for permanent grass or noncrop uses. Also offer cost-sharing arrangements for initially improving or establishing grass cover or other facilities required for grazing use. (The cost-sharing on trees, recreation, and wildlife are discussed below.)

An easement on land not suited for cultivated crops would provide permanent protection against unwise use of this land for cultivation.

As will be discussed later, consideration should be given to local area land-use plans in administering this program. Applications would be reviewed by county committees to select the farms and land in the county to be accepted under either category A or B. Agreements or easements would not be considered where county committees rule the area ineligible because urban or other developments indicate the land soon will be out of crop production anyway.

3. For some of the lands in category A that are intermingled with publicly owned grazing lands, public land purchase and management should be considered. Loans to approved local organizations of land users might be made for land purchase to establish grazing districts.

4. For category B (grassland reserve--land suited for crop use) an offer should be made to cost-share the work needed initially to improve or establish grass cover and livestock water. The owner would be permitted to graze it or cut hay provided:

   (a) He would refrain from returning the land to cultivated crop use in return for a stated annual rental per acre. This would initially be administered on a year-to-year basis with options for the Government to renew for a stated term. Longer-term agreements would be desirable, but additional authorizing legislation would be necessary. The rental offered should be based on the fair difference between the expected return from the use of the land for pasture or hay and what it probably would net if planted to the cultivated crop to which such land in the area most likely otherwise would be devoted.

(b) If the owner breaks his agreement he would be required to refund the rentals (not the cost-share payments) that have been paid. This arrangement would allow the farmer to withdraw by repaying all rentals he had received under the agreement. This also would permit the Government to withdraw by not renewing the annual offer, in which case the farmer would not be bound for subsequent years of the agreement.

The plan for Category B (grassland reserve) would not attract all the Conservation Reserve land that is the best suited for crop production. The plan might, however, attract many acres of Conservation Reserve lands that farmers are not too pressed for using at this time. Also, many other farmers might enter their lands in the grassland reserve. If livestock use can be established on these lands the chances are very good that they will not come back into crop use at the end of the contract period.

Rental payments might be partially financed by payment-in-kind from CCC stocks.

The estimated acreages of cropland in categories A and B that might be converted to grass follow:

(Million acres)

Item	20-year projection	First 5-years	Second 5-years	Third 5-years	Fourth 5-years
Category A (easements)	12	6	2	2	2
Category B (rentals)	26	19	5	1	1
Total	38	25	7	3	3

Conversion of Cropland to Trees

A program is needed to convert cropland to trees to aid in land-use adjustment. The proposal is for a voluntary program under which farmers would agree to establish and maintain tree cover on cropland placed under contract for a stated number of years.

For cropland placed in category A (lands unsuited for crop use) that should be permanently in trees, owners would be offered a lump sum payment for a long-term easement which would insure noncrop use.

Cropland placed in category B (lands suited for crop use) could be considered for conversion to trees under the same terms as indicated for category A lands or under an alternate rental agreement. Lands already planted to trees would not be eligible under either arrangement. However, as an inducement to holders of such land to maintain it in trees, long term, low interest, deferred payment loans or cost-sharing for timber stand improvement would be offered if and when improvement measures are needed.

Features of a possible rental agreement are:

1. Owners could receive an annual rental for 15 years for refraining from returning the land to cultivated use during the period.

2. Bids or other procedures would be used to determine the specified annual rental acceptable.

3. If the owner breaks his agreement he would be required to refund all the rental payments (not the cost-share payments).

The minimum amount of land permissible under either arrangement (easement or rental) should not be less than two acres. Under either arrangement, the Government would share the cost of planting. Owners could harvest forest products during the contract period if such harvesting was done according to good forest practices.

Public purchase and management would be considered where croplands suitable for timber production are mingled with other public forest lands or where croplands suitable for timber production could be acquired in blocks large enough to be administered as public forests.

The estimated acreages of cropland in categories A and B that might be converted to trees follow:

(Million acres)

Item	20-year projection	First 5-years	Second 5-years	Third 5-years	Fourth 5-years
Category A (easements)	9.0	3.0	3.0	1.5	1.5
Category B (rentals)	10.0	3.5	3.5	1.5	1.5
Total	19.0	6.5	6.5	3.0	3.0

Recreational Opportunities in Agricultural Programs

Recreational facilities can provide additional income to people in rural areas and permit diversion of some land to higher, more beneficial public uses.

The following program is proposed:

1. Federal cost-sharing, credit, and technical assistance would be provided to local organizations under the Watershed Program for development of recreational capacity in selected watershed reservoirs and for acquiring the land and providing associated minimum basic recreational facilities to serve public recreational needs in the immediate watershed area. Federal cost-sharing, credit, and technical assistance would also be provided to local organizations for acquiring selected lands and associated minimum basic recreational facilities along streams, lakes, marshes, or other water areas for recreation, wildlife, and open space uses. Special attention should be given to flood plains for which it would be difficult or expensive to provide flood protection. Thus, shifting the land to uses that do not require flood protection would be an alternative to high-cost flood control works. In all cases the reservoirs, lands, and recreational facilities would be operated and maintained for public use by the local sponsoring organizations.

2. Development of recreation as a farm enterprise should be promoted by assisting farmers in diverting cropland to recreation use and by providing technical assistance and credit to help them develop ponds, hunting, fishing, and other recreational facilities in conjunction with balanced farm plans.

3. Where the lands involved in the agricultural use adjustment program are adjacent to urban areas, consideration should be given to local plans for "open space" needs. Cooperation would be offered to local governments in planning and developing rural lands for open space purposes. The activity would be coordinated with the open space land program of the Housing and Home Finance Agency.

It is estimated that assistance for recreation, wildlife, and open space uses might be given on 125 to 150 thousand acres annually.

Relation of Land-Use Adjustment to Local Plans

Local, State, and regional land-use plans and programs should be fully considered in the administration of Department land-use adjustment programs. Maximum use should be made of activities and programs concerned with watershed projects, soil conservation districts, conservancy districts, drainage districts, irrigation districts, mutual irrigation companies, river basin planning, rural areas development, and other regional, State, and local organizations with which the Department cooperates to attain land-use adjustments. The objective should be to achieve maximum local and regional benefits in addition to national objectives of balanced land use.

Cooperative arrangements with States and with other Federal agencies should be sought by Department agencies to encourage land-use planning and land-use controls that will contribute to the land-use adjustment, development, and planning needs set forth in this report. Cooperating farmers and organizations should be expected to assume responsibility for being in conformance with State laws and with zoning ordinances and other official land-use regulations governing land and water development.

Land and Water Conservation and Development

Soil and Water Conservation

An estimate of the cost of soil and water conservation practices needed on non-Federal rural land was made by applying current costs to data from the recent USDA Conservation Needs Inventory.

Measures included are those which experience shows are likely to be used in meeting the types of conservation problems inventoried. Some land treatment measures will need to be applied more than once during the next 20 years on some of the lands involved.

Costs for these have been repeated where appropriate. Costs were not included for maintenance-type operations and, therefore, costs are limited to initial applications and to repeat applications. This estimate takes into account only the direct costs of materials, labor, and rent of equipment. Such indirect costs as the loss of income or the deferment of income from the land due to the application of the conservation measures are not included.

On the basis of the foregoing, a total private and public investment of approximately $50 billion would be required if the conservation needs shown by the National Inventory are to be met. About $33 billion would be required for conservation practices on cropland to solve problems caused by erosion, excess water, unfavorable soils, or adverse climate. Approximately $10.5 billion would be needed for conservation measures for establishment and improvement of pasture and range. About $6 billion would be necessary for establishment or improvement of farm woodland and commercial forests.

The rate at which the needed conservation practices will be applied is dependent largely upon three factors: First, the extent to which public assistance programs are available to reduce the share of the total cost that the landholder otherwise would be required to bear; second, the extent to which landholders have a favorable balance of income over costs of operation to invest in conservation; third, the extent to which technical assistance (including soil surveys) is available. Past experience indicates that landholders assign a relatively low priority to conservation investment in relation to some of their immediate operating costs. There is no indication that this will change.

The benefits to be derived from meeting the Nation's conservation needs cannot be completely measured in monetary terms. Farmers benefit from the resulting continued productive capacity of their land. The entire Nation benefits by maintaining our basic soil and water resources. Adequate application of needed conservation measures will mean in the long run that as a Nation we will pay less for our food and shelter. The projected crop yields used in the analysis of future productivity are based on the assumption that application of conservation practices over the next 20 years will be at the rate experienced in the 1950 to 1960 period.

The current value of farmland exclusive of buildings has been estimated at $110 billion. The estimated conservation costs are for the protection and maintenance of this farmland. If the conservation practices included in the Conservation Needs Inventory were applied over a 20-year period, the average annual conservation

expenditure of $2.5 billion would equal nearly 10 percent of present annual farm operating costs. Such a projected annual conservation expenditure, moreover, would be about 20 percent of the current net income from farming.

Currently about 4 to 6 percent of net farm income is being invested in soil, water, pasture, and forest conserving measures. Over 60 percent of these measures are accompanied by Federal cost-sharing, for which the Federal share is slightly less than one-half the total cost.

The current annual conservation investment is estimated at $750 million, of which about 30 percent is Federal and 70 percent is non-Federal. Most of the non-Federal investment is by individuals. These estimates do not include forest conservation measures carried out by the timber industry.

Unless a greater portion of farm income than at present can be channeled into conservation investment, a billion-dollar increase in net farm income would yield at most a $60 million increase in conservation investment. Therefore, increased income along cannot be relied upon to achieve an annual investment in conservation comparable to what is estimated to be needed.

The public has a great interest in maintaining the Nation's basic resources and could ill afford not to bear the costs of this protection if no other alternative existed. Experience shows, however, that landholders can and will bear a reasonable part of the cost. Experience also shows that farmers will better use and maintain the needed conservation practices if they have a direct investment in them.

It appears that the attainable rate of public and private investment during the next 20 years would meet about one-third to one-half of the estimated cost of conservation needs. Programs for conservation should continue to be reviewed with the objective of securing the greatest benefit from the investment of limited public and private funds.

Small Woodland Development Program

Fifty-three percent of the Nation's total commercial forest lands, amounting to about 257 million acres, is in farm and other relatively small private ownerships. Achievement of long-range timber growth goals for these small ownerships is largely a matter of restoring depleted inventories.

The Department is now engaged in preparation of a comprehensive program to accomplish needed improvements in farm and other small private forest ownerships. The need for such a program to enlarge and supplement exisitng cooperative efforts has been well established. For example, the backlog of needed work that has gradually developed on small private woodlands in past decades in millions of acres is: complete reforestation, 40.7; partial reforestation, 10.0; and timber stand improvement, 96.3.

In addition, most timber cutting on these lands has been and is still done without regard to even minimum standards of forestry practices. Losses from fire and pests are still far above acceptable levels and should be reduced through aggressive cooperative programs which effectively combine private, State, and Federal efforts. Insufficient continuity of management, unfavorable economic factors, and lack of motivation are examples of other problems to be overcome through a comprehensive small-woodlands development program.

The consolidation and rehabilitation of some 20 million acres of seriously depleted and fragmented ownerships is an essential requirement of such a program. Forest nursery capacities will need to be expanded to support large-scale planting programs, and increased education, credit, and technical services will be required to implement the program effectively. Retirement of cropland and pastureland to tree cover, as described previously, existing cooperative programs, and independent private efforts will be reflected in the Department's overall small-woodland program being developed at this time.

Activities involved in planning, land diversion, planting, and applying conservation practices on farm woodland and commercial forests are partly included under sections on Conversion of Cropland to Trees, Soil and Water Conservation, and Farm Planning.

Watershed Installation

Watershed projects provide an opportunity for integrating Federal assistance and local plans and objectives for land and water developments and adjustments. Whenever overall river basin plans are available, the objectives and purposes of watershed projects will be made consistent with such plans.

The Soil and Water Conservation Needs Inventory shows that small watersheds containing about 1 billion acres have land and water problems requiring project-type action for their solution. We estimate that about one-third of the needs inventoried can be met in the next 20 years. This would require inclusion of 333

million acres in watershed projects under construction or completed by the end of the period, including 55 million acres in currently authorized projects with treatment completed on about 18.5 million acres.

The additional acreage proposed for inclusion in projects is:

(Million acres)

Unit	20-year projection	First 5-years	Second 5-years	Third 5-years	Fourth 5-years
Watershed projects--	314.5	48.5	80.0	92.0	94.0

Based on benefit and cost estimates for 289 work plans authorized for operations on January 1, 1961, it is estimated that the projects will yield about $2 of benefit for each dollar of cost. The nature of these benefits are such that they accrue to a very wide segment of the public. These include: reduction in damages from floodwater and sediment; increases in net income from changed or more intensive use of property; increase in net income as a result of drainage and irrigation; savings in the cost of water treatment resulting from the reduction of sediment in industrial, municipal, and domestic water supply; and value of municipal and industrial water supply to be furnished by the project.

In addition, certain other benefits not evaluated in monetary terms will accrue, such as improved business opportunities in the watershed, prevention of loss of life, enhancement of fish and wildlife resources, recreational opportunities, and water quality control.

National Forest Development

Expanded resource management and development work is needed on the National Forests and Grasslands to provide assurance that these public lands will meet their full share of present and future needs. The basic renewable natural resources of the National Forest System upon which the Nation will rely to an increasing extent in the years to come are water, timber, forage, recreational attributes, wildlife habitat, and esthetic natural surroundings. Under the proposed program, management and utilization of National Forest and Grassland resources will keep pace with population growth and national economic development.

National Forest Watersheds will be protected and rehabilated by soil stabilization and management of the area in such a way as to maintain or improve water quality and quanity. The program proposes: The completion of soil surveys on 29 million acres; 9,000 miles of gulley and channel stabilization; 1.3 million acres of sheet erosion control; 10,000 acres of dune and blowout stabilization; erosion control on 13,000 miles of substandard roads and trails; 5,600 acres of waterspreading; 410 flood prevention structures; and 160 pollution control projects.

The long-range timber goal for the National Forest System is an annual harvest on a sustained-yield basis of 21.1 billion board-feet of sawtimber by the year 2000. The program proposes to increase the harvesting to reach an annual cut of 13 billion board-feet by 1972. During the next 10 years 3.8 million acres of nonstocked and poorly stocked plantable lands are scheduled to be seeded or planted and over 10 million acres of immature timber will receive cultural treatment such as pruning, weeding, thinning, release cutting, and plantation care.

The long-range needs for the development and management of the 60-million acres of rangeland in the National Forest System are: to obtain and maintain desirable forage of high capacity; to construct, rehabilitate, and maintain range improvements needed to attain intensive management on all ranges; and to make adjustments in numbers of livestock or seasons of use when necessary. Substantial progress toward these long-range objectives is scheduled in the next 10 years and includes complete analyses and plans on 7,600 allotments, revegetation of 4 million acres, and construction of 16,000 miles of fence and 8,100 water developments.

The growth and development of the Nation has had a great impact on the National Forests in increased use of the recreation resources. It is estimated that this use will rise from the 92.5 million recreation visits of 1960 to 195 million visits by 1972, with a continued rapid annual increase to a possible 635 million visits by the year 2000. The schedule of recreation resource management for the next 10 years includes: The reconstruction and rehabilitation of more than 2,000 existing campgrounds; planning and developing 28,000 new campgrounds and picnic sites; planning and developing 4,000 other recreation sites including swimming, boating, winter sports, and public service sites; the preparation of complete management and development plans for all recreation sites and areas; the maintainance of facilities and provision of sanitation and cleanup for 195 million visits.

In 1960, one-quarter of the 92.5 million recreation visits to the National Forests and Grasslands were for the primary purpose of hunting and fishing. This use is expected to increase to about

50 million visits by 1972. The long-range need of habitat management is to make it fully productive to support fish and game populations needed for public use and enjoyment. The program for the next 10 years is: to improve 1.5 million acres of game range, 7,000 miles of stream, and 56,000 acres of lakes; to develop 2,000 wildlife watering facilities, 400,000 acres of wildlife openings, food patches, and game ways; and to carry on rodent control on 11 million acres.

Protection of National Forests from fire, insects, disease, weather, and destructive animals is a task of major proportions. The long-range need is for better facilities and techniques for fire control; for more resources to cope with critical fire periods; and for a more intensive application of a program of prevention, detection, and control of insect and disease infestations. In the next 10 years, insect and disease control on the National Forest System will be increased to a level that will substantially reduce the occurrence of large infestations toward the end of the period. This will require an approximate 40-percent increase over the present level of protection. During this period, fire protection (including manpower, equipment, and aerial operations) needs to be increased to approximately two times the present level; hazardous fuels on 4 million acres will be reduced, and 11,000 miles of firebreaks will be constructed.

To provide and maintain a system of forest development roads and trails which will adequately service the National Forest System at the levels needed to meet expected needs and optimum production of products and services will eventually require construction of about 379,900 miles of new roads and 6,000 miles of new trails, along with the reconstruction to higher standards of about 105,000 miles of roads and 10,500 miles of trails. The scheduled goal for the next 10 years is the completion of the construction and reconstruction of about 79,400 miles of multiple-purpose roads and 8,000 miles of trails. It will also be necessary to provide maintaneance on the 268,900 miles of existing access roads and trails and on the new roads and trails constructed during the period.

Within the units in the National Forest System, the pattern of landownership is quite irregular. In some units, National Forest ownership is well blocked. In many others, the previous patenting of land under the public land laws, or the way in which the land was available for purchase, resulted in a scattered pattern of ownership. The long-range need is to acquire, by exchange or purchase, about 720,000 acres in key tracts needed to facilitate public recreation use of National Forest land. Additional land purchases of about 7 million acres are needed, primarily in the East. During the next 10 years about 1.5 million acres

of Federal land in National Forests and Grasslands should be exchanged for suitable private land to consolidate ownership. During this same period, the program calls for purchase of about 500,000 acres which are important for recreational use and about 950,000 acres of inholdings important for other purposes.

To facilitate resource management and development work, construction and maintenance of administrative and fire control improvements will need to be provided at an increased rate in the 10-year period. New construction plans include 2,640 dwellings and related improvements, 2,500 service buildings, and 455 lookout structures. Completion of the communications system needed for protection and management of the National Forests will require 2,000 additional radios and replacement of 9,000 radios and 3,000 miles of telephone line. The increasing use of aircraft will require an additional 25 landing fields, reconstruction of 37 existing fields, and construction of 1,820 heliports and helispots.

Direct financial revenues from the National Forest System are expected to rise to about $230 million annually by the time the 10-year development program is completed. On the current basis of fees for uses and products, over 90 percent of revenues will continue to come from the sale of standing timber. The capital value of the timber, forage, and lands of the National Forest System should increase by about $2 billion as a result of the program. Intensified management of the National Forests should be reflected in increased cash receipts. However, the real benefits of this development program will accrue during the years ahead in satisfying the many and increasing demands upon this particular national resource.

Land Consolidation and Redevelopment

The transfer of farm people from rural areas has been accompanied by idle land and unused buildings on thousands of small tracts in low-income rural areas. Many of those tracts are held as a form of security by families with insecure off-farm work. Other tracts that are virtually neglected provide residences for ex-farmers who are engaged in nonfarm work or who are retired. Still other low-income farmers continue to mine their resources in an attempt to eke out an existence on tracts improperly managed or too small to provide an adequate family income. This situation calls for positive assistance in redirecting the use and management of the resources involved, and in reorganizing small tracts into ownership and management tracts of economic sizes.

The low-income farm areas constitute about one-fifth of all the farm areas in the United States. The land operated per farm in these areas averages about one-third the size of farms in the higher-income areas.

The problem of developing adequate farm units should be met by the concerted efforts of the Department of Agriculture as a specific goal of rural area development. Concentrated attention should be given to this problem by the administrators of Department programs of credit, cost-sharing, technical assistance, and education. It is recognized that progress with these economic, social, and institutional adjustments will be contingent upon the full cooperation of those competent farm families who are earnestly seeking a way of developing adequate family farms.

In addition it is proposed that the credit authority of the Department be expanded to provide loans to local public corporations, vested with appropriate powers, through which the affected lands could be acquired for resale for redevelopment. The major activities of the corporation might be as follows:

1. Buying and reselling land for purposes of ownership consolidation, land-use changes, and redevelopment. For example, this program could be used to consolidate small ownerships into larger farms. The activity could promote adequate family farms as well as forest recreation and other developments.

2. Buying and organizing a number of adequate farm units on which selected farm families could progress toward ownership while operating under a long-term lease.

3. Buying or exchanging lands to be leased out. Some leases could contain option to buy. The corporation leasing of scattered tracts would be used largely to supplement inadequate farms; to change, or add enterprises on existing farms.

4. On an experimental basis, some lands might be sold under flexible financing arrangements.

Administration of this program would be integrated and coordinated with credit and other rural development programs. As is now done with grazing districts, some lands could be locally administered subject to general rules of the public corporation or agency responsible. Any program of the kind proposed would necessarily involve local government, its services and revenues. Hence, appropriate coordination of Federal, State, and local government would be necessary.

A large proportion of the costs of land purchase and redevelopment could be recovered through resale or rental of land other than that reserved for public use. Benefits of such a program would be primarily in terms of efficiency of operation, improved farm income, value of improved timber and grass production, recreation development, improved community services, and increased tax returns from otherwise unemployed resources.

Based on past trends, the number of farms is expected to decline materially by 1980; this decline would be accompanied by drastic readjustments, economic dislocations, and maladjustment of resources. Thus, it would appear that there is a pressing need for land consolidation and redevelopment activity. However, at this time only a pilot program is recommended, together with careful study and evaluation of the possible approaches to this problem.

Family Farm Improvement

A major objective of the Department of Agriculture is to provide appropriate and needed services to preserve and improve the family farm pattern of American agriculture and to improve farm and rural living.

In developing and administering land-use adjustment and conservation programs and through application of the Department's rural development and credit services it should be feasible to help develop approximately 400,000 to 600,000 fully adequate family farm units by 1980 from land and water resources that may become available through voluntary transfers. During this period, programs should be undertaken to provide rural development, credit, and training assistance to facilitate the shift of some farm families, who are now on farm units which do not provide a living and full employment, into other gainful occupations. This adjustment will benefit the families and permit needed adjustment in land use. It also will make additional resources available to farmers who remain in agriculture.

Farm families who do not have good economic alternatives because of age, ill health, education or personal preference, and are unable to leave their present situations will be assisted to achieve the maximum rehabilitation possible.

While operator-ownership of farmland is to be encouraged, it is recognized that some family-farmers will continue to be renters or part-owners; this may for a time, or in some circumstances, represent the most desirable tenure position for them. However, a program of farm-ownership loans should be accelerated to provide improved access to credit for farm ownership by qualified farm families.

Promotion of adequate housing is essential to a desirable pattern of land occupancy. Loan and grant programs should be extended to improve housing for owners, tenants, hired labor, and migratory workers on farms.

Credit, research, and technical assistance programs should be focused toward providing modern electric, domestic water, and communications services and in applying these services to the needs of agriculture and to the improvement of farm and rural living.

About 94 percent of the funds required for these programs would be recovered with interest. The remainder would cover administrative costs and losses.

Land and Water Use Planning

Farm and Ranch Planning

The justification for providing technical assistance at public expense to individual farmers, ranchers, and other landowners is to assure the protection of productive agricultural land to meet future needs of the Nation and to help present farmers and ranchers to develop the most efficient use of soil and water resources, taking into consideration present national production needs. The farm or ranch plans that farmers and ranchers develop with this technical assistance are designed to provide a high level of net income to the individual operator, maintain the productive capacity of the land, and enable each operator to use National farm adjustment programs effectively on his operating unit.

Soils differ greatly in their characteristics. Farmers and ranchers need assistance in recognizing the potentials and limitations of their soils and the income possibilities of different land uses. The low income situation presently prevailing in some sections of the country and on many farms stems in part from attempts to use land for purposes beyond its potential. The Department should move forward with a program to provide farmers and others with soil surveys, including land capability and other interpretations, and technical assistance which can be used for bringing about needed land-use adjustments and conservation treatments wherever necessary to make operating units economically sound on a sustained basis.

Many operating units are too small to sustain a farm family, and many units have a large percentage of land unsuited for intensive agricultural production. Some of these, however, are strategically located and are well suited for other uses of land, such as

recreation, wildlife, woodland, and water resource development. In many cases, a combination of two or more farm units may be necessary to bring together the appropriate combination of land-water resources for an adequate-sized family farm. Such land-use adjustments generally require credit and financial management as well as land resource improvement performance in excess of the usual experience of farm operators in such areas. Farm families who have the desire may remain in the community on a full-time farming basis when an adequate family-sized farm unit can be brought together.

To be fully effective in meeting national objectives of wise use and conservation of soil, water, and plant resources and to balance production with requirements, the several action programs of the Department should be coordinated and adapted to the needs of individual farms and ranches. The feasible time to accomplish such an objective is at the time of rendering planning assistance to farmers and ranchers on their entire operating unit. This opportunity arises when long-range, as well as short-range, decisions are being made by those who own and control the land. To this end it is proposed that an expanded and coordinated effort be inaugurated for technical assistance, cost-sharing, and credit to landowners for use in developing and applying their conservation plans on entire operating units. The preparation of a definite plan and schedule should take account of suitable alternative land uses and combinations of permanent conservation practices. Farmers and ranchers should have the option of cost-share assistance and technical assistance through the instrument of a contract for the entire operating unit to allow orderly progression over an appropriate period of years or to receive assistance on an annual basis. Loans and cost-sharing for installing permanent conservation practices should be predicated on a definite conservation plan and schedule in accordance with program objectives.

The following projection of future needs for farm and ranch conservation planning and conservation treatment application in the U. S. is based on (1) the number of tracts and acres already being farmed with conservation plans; (2) the estimate of conservation requirements on land still needing conservation treatment; and (3) the estimated acreage on which revision of plans becomes necessary due to shifts in land use, changes in crops grown, or type and size of farming operations, and advances made in conservation farming methods through research, advanced technology, and through better understanding of interrelated conservation treatments used. Each of these points has been considered in projecting national goals for the next 20 years. Changes in landownership, number and size of operating units, and national production requirements in the years ahead may affect the net results during any of the 5-year intervals.

To move ahead more rapidly on soil and water conservation on private land, it is highly desirable to raise the rate of planning to at least 200,000 farms and ranches annually, and to increase the number of plan revisions from 40,000 to about 100,000 annually.

While considerable progress has been and is being made in the application of needed soil and water conservation treatment to the land, the present rate is too slow to encompass the 80 percent of private lands needing conservation treatment by 1980. The present level of technical assistance for conservation planning and application of practices should be increased by at least 50 percent during the first 5-year period and another 30 percent during the second 5-year period--or about 80 percent above the 1961-62 level. With increased volume in the work and improved efficiencies, a continued reduction in unit cost of planning and application is expected.

The desirable goal for technical assistance to landowners and operators for conservation planning and the application of practices follows:

Item	20-year projection	First 5-years	Second 5-years	Third 5-years	Fourth 5-years
Number of conservation plans (thousand)	3,650	750	900	1,000	1,000
Number of plan revisions (thousand)	1,425	225	300	400	500
Total (thousand)	5,075	975	1,200	1,400	1,500
Acres (million)	1,068	222	264	292	290

Conservation plans are prepared with technical assistance for farms and ranches, suburban tracts, rural residences, private timber holdings, and other tracts of land having soil and water problems. The projections were made with the expectation that about 80 percent of the acreage in private ownership could and should be planned by the end of this 20-year period.

Revisions are necessary due to changes in acreage, consolidations of farms, and subdivision of larger holdings. Such adjustments in conservation plans should average 3 to 4 percent of the cumulative plans each year. Technical assistance is necessary to help each landowner prepare a conservation plan for the land he operates and to keep his plan up to date with advancing technology.

The estimated acres reflect the net increases during each 5-year period after adjustments for cancellations and other changes are made due to changes in land use, urbanization, highways, airports, reservoirs, and other nonfarm uses. This is the increased acreage for which technical assistance will be needed over a 5- to 8-year period in helping landowners design, lay out, and install the planned conservation practices.

Technical assistance in conservation planning includes on-site help to farmers, ranchers, and other landowners; group enterprise systems for water management affecting several adjoining tracts; periodic revision of plans to reflect necessary changes; and the guidance needed to get planned soil and water conservation treatments properly installed on the land. Assistance to cooperating State and local agencies with program maintenance and improvement is also included. This phase of the conservation job on private lands is expected to increase substantially during the next 20-year period.

Watershed Planning

Within the framework of available comprehensive river basin plans and in response to applications for assistance from local organizations, with approval by the States, detailed programs and plans are formulated for upstream watersheds to carry out the objectives previously described. Plan formulation and evaluation requires skilled and experienced technical specialists as well as knowledgeable and determined local leadership.

The estimates of planning requirements, including Federal funds needed, are based on the considerations previously stated that the maximum reasonable goal would be to meet one-third of the watershed needs indicated by the Conservation Needs Inventory by the end of the 20-year period. Plans have been completed or are underway on 400 watersheds. Plans would be required on 5,200 additional watersheds to meet the goal for the 20-year period. The additional projects estimated to be planned in each of the 5-year periods follow:

Unit	20-year projection	First 5-years	Second 5-years	Third 5-years	Fourth 5-years
Number of projects	5,200	800	1,300	1,500	1,600

Comprehensive River Basin Planning

Comprehensive river basin planning provides framework plans for coordinated works of improvement for the conservation and development of water and related land resources in both the upstream and downstream areas in river basins. The Department of Agriculture's participation in the preparation of comprehensive river basin plans involves determining and meeting the needs for agriculture (including forests and grasslands) in such basins, and for municipal and industrial water supplies, power supply, flood protection, drainage, water quality control, and fish and wildlife enhancement and recreation in the upstream watershed areas. As a part of such planning, the Department develops information on needed land-use adjustments, soil and water conservation measures, and production requirements to obtain sustained and efficient agricultural production on all of the lands in the basin under the conditions that are expected to prevail in the future.

In his Special Message on Natural Resources, February 23, 1961, President Kennedy stated, "This Administration accepts the goal urged by the Senate Select Committee to develop comprehensive river basin plans by 1970, in cooperation with the individual States."

The development of comprehensive river basin plans will require participation by all of the concerned Federal, State, and local agencies. The present rate of planning falls far short of the President's goal. It is estimated on the basis of the current schedule and at the scale of intensity of planning used in recent comprehensive river basin surveys, that during the next 20-year period comprehensive plans would be completed on one-half of the approximately 100 river basins remaining to be planned in the contiguous 48 States. Limitations on recruiting and training technical specialists and ability of non-Federal units of government to participate would need to be overcome if funds were provided for a faster rate of progress.

Soil Surveys

Soil surveys have many uses such as: broad land-use planning; land-use adjustments; detailed farm, ranch, and watershed planning; land appraisal; tax assessment; highway engineering; urban-fringe planning and development; agricultural research planning; and many other uses. The soil survey is based on intensive study of our land.

Soil surveys include soil maps and appropriate text. The published text includes descriptions of the soils and statements as to their productive capacity and potential uses. The hazards and limitations of each soil are given for each of the adapted land uses. Rapidly changing interpretations, such as fertilizer recommendations and crop varieties, are given in frequently revised

handbooks and State leaflets. Soil surveys show the location of soils suitable for cultivation and those not suitable. They serve as a basis for determining the combinations of practices needed to bring out and to maintain the productive capacity of soils.

Information is gathered about individual soils from correlative research, experience of farmers and ranchers, field trials, laboratory studies, and from other sources. Estimates of proposed program accomplishments based on the rate that trained soil scientists are expected to be available follow:

Item	20-year projection	First 5-years	Second 5-years	Third 5-years	Fourth 5-years
Acres mapped (million)	1,651	390	785	476	-
Number of man-years	51,725	12,225	16,875	12,625	10,000
Number of publications	2,816	257	634	800	1,125

It is recognized that the above rate is slower than is desirable from the standpoint of the critical need for soils information. The program includes the revision of approximately 80 million acres of earlier surveys.

It is estimated that beginning in about 1975, a maintenance staff of approximately 1,150 soil scientists will be required to keep soil interpretations and soil mapping up to date and in line with new developments in agricultural technologies and to provide on-site technical assistance to conservation planning technicians and others.

It is estimated that about 10 percent of the cost of soil surveys will be borne by State and Federal agencies outside the Department of Agriculture, such as Bureau of Indian Affairs, Bureau of Land Management, and Land-Grant Colleges.

Research Program

The entire research program of the Department in farm research, economics, marketing, utilization, nutrition and consumer use, farm electrification, and forestry should be greatly strengthened in order

to accomplish the general objectives set out in this report. Present levels of research activity in these fields amount to about $120 million annually, and research efforts should be substantially expanded.

Within the research program projected, specific areas requiring research emphasis are:

1. Grass, browse, and harvested forage.- The 1980 projection indicates a substantial need for more pasture, range, and harvested forage. In order to meet this need, there should be greatly accelerated research on breeding grasses and legumes for large, vigorous seedlings in order to reduce hazards of stand establishment; on high-yielding, vigorous, adapted, palatable, nutritious forage plants; and on disease and insect resistance. Also needed are studies on machinery for seeding, harvesting, pelleting, and handling forages to reduce present excessive labor costs and to preserve nutritive values of forages. Pasture and range research to develop suitable management systems for the many different types of vegetation, livestock, and game should be accelerated.

2. Soil management.- There should be a rapid expansion in soils research, especially in basic research necessary to control wind and water erosion, salinity, soil properties, processes and management; on soil-water-plant relationships; on the interaction of fertilizer, water use, crop variety, pesticide use and tillage and other management practices; and on efficient, economic, and sustained conservation farming. We also need expanded research on nutrition of animals and man as affected by properties and characteristics of soils, plants, and climate.

3. Hydrology and water management.- An expanded research program in basic and applied research in hydrology and water management is essential to achieve maximum beneficial use of our limited water resources for domestic, agricultural, industrial, and recreational use and to protect our soils, reservoirs, and urban areas from water damage. Research is needed on sedimentation, watershed hydrology, hydraulics of irrigation, drainage, and watershed protection; on water supply structures, channels, and facilities; on conservation of water supplies for agricultural use; on irrigation design principles, requirements and facilities; on moisture conservation for efficient and effective use of precipitation on crop and range land; and on the management of forest and range vegetation to influence quantity, quality, and timing of water yield.

4. Protection against diseases, insects, weeds, and other pests.- In order to assure maximum opportunities for multiple use of farms, forests, streams, reservoirs, ponds, lakes, and wetlands use for

agriculture, forest products, game, recreation, and rural living, we need expanded research on the development of more effective control methods against crop, livestock, household, and other pests--insects, diseases, weeds, fire, air and water pollution, and chemical residues. Emphasis on basic research on biological and cultural control of insects and diseases, and on the nature of insect resistance to insecticides, especially on genetic resistance and the nature of genetic resistance to pests, is urgently needed. Methods for control of phreatophytes and of rodents; research on the population ecology of game species and of songbirds; and research concerning the habitats for game and fish are needed.

5. Agricultural adjustment.- More economic research on existing and alternative prospective programs of supply, management, and price and income support, and their effects on conservation and use of land and water resources, is needed. Basic research to develop models, methods, and to evaluate probable costs and returns in order to develop agricultural programs which would more effectively or economically provide adequate income for farmers, should be greatly expanded.

Expanded research on problems of agricultural adjustment should emphasize studies of land tenure; credit; aggregative analysis of the impact of adoption of new technologies; interfirm integration and specification buying; migrant labor and the effects of unionization of farm labor; training and educational needs; economics of farm size; assembly, processing, and distribution of farm products; consumer acceptance and food habits; and alternate use of purchased and nonpurchased inputs.

More economic research on new crops, on new industrial products from agricultural raw materials, and the utilization research to make them feasible is needed.

6. Low income farms.- Research addressed to the special problems of low income farms should be expanded with emphasis on the feasible combinations of labor-intensive crops, especially grass farming with sheep and cattle, small fruits, vegetables, ornamentals, poultry, feeder pigs, and replacement heifers; on machinery adapted to small fields, economical and flexible in use; on soil and water research adapted to soil-building in hill lands; on improved farm forestry; on wildlife habitat; on fish farming; and on housing and family living, including training in use of credit and feasibility of income supplementation from recreation, game, and fish. Economic research and other social research to assist in bringing as many low income farms to economic adequacy as should remain in farming should provide leadership for a special low-income farm-research

program. Research is needed on utilization of lower quality timber and little-used species, typical of farm forest properties, to aid in development of new and diversified industries and outlets for timber products.

7. Resource economics.- An expanded program of economic research on the conservation, development, management, and use of land and water resources is essential to guide resource policy and program decisions. Types of analyses needed include: future national requirements for resources, production potentials, and competition between resource uses to guide the establishment of resource policy and programs goals; standards and procedures for the formulation, evaluation, and selection of land and water development programs likely to contribute effectively to economic growth and stability; equitable arrangements for inducing participation and sharing program benefits and costs; adequate legal bases and organizational arrangements for implementing resource programs; the application of resource management and conservation practices and measures to maximize returns at the farm level; and impacts, compensation, and implementation aspects of resource development and land-use adjustment programs and measures.

8. Farm electrification research.- Optimum utilization of land and water resources can be materially assisted through expansion of research and development activity in applying electric energy to farm operations, environment, and living. More research needs to be conducted in the application of electric lighting and other radiation to animals, plants, seeds, and insects, and in new and more effective applications of electric energy to cut farm production costs, produce better farm products, and conserve human energy.

9. Forestry research program.- The forestry research program should be expanded to supply the knowledge required to put forestry on a sound technological basis. Such support is esenntial as natural resource production, protection, and utilization move rapidly ahead. Similar research by forest industries, States, forestry schools, and others is needed. Coordination of all forestry research should continue to receive major emphasis.

Highlights of the program objectives are:

Timber - Improve planting stock and tree seed sources through genetics. Develop methods of reforesting problem areas, classifying productivity of forest soils and sites, and improving timber yields.

Forest soil and water - Improve land use practices to preserve favorable hydrologic conditions. Develop methods to promote snow accumulation and regulate streamflows, increase

infiltration into the soils, decrease evapotranspiration losses, and stablize soils in problem areas.

Range forage - Improve basis for estimating livestock carrying capacity and for judging range condition and trend. Develop systems of management to maintain desirable vegetation, to protect soil, water and forage values, and methods of range improvement such as prescribed burning and rodent control

Wildlife and fish habitat - Determine wildlife populations that can be supported by various vegetation types. Increase carrying capacity by manipulation of vegetative cover. Improve opportunity to coordinate wildlife production with timber growing, domestic livestock, and other uses of forests and rangeland.

Forest recreation - Improve methods of selecting, developing, and managing forest areas for mass recreation use. Determine characteristics of recreation demand and how recreation structures and facilities may be established and maintained most effectively.

Forest fire - Reduce man-caused fires and fire-starting potential of lightning storms. Improve methods of planning and organizing fire control activities as well as improving suppression procedures.

Forest insects - Improve methods of detecting and controlling insect problems. Develop better biological, chemical, and other tools to protect both standing timber and wood products.

Forest diseases - Expand knowledge of all aspects of major forest diseases as a basis for control. Develop methods to reduce impact of disease upon the forests and upon wood products.

Forest products - Improve wood products through more effective preservation and better seasoning, glues, and manufacturing practices. Find profitable uses for unused woods and residues through new or improved pulping processes or other means. Perfect knowledge of lignin, bark extractives, and other wood properties.

Forest engineering - Improve all aspects of mechanization in forestry practices including logging, site preparation, road building, and primary processing.

Forest survey - Maintain basic inventory data on area, volume, condition, distribution, and other aspects of the forest situation. Determine timber harvest, growth, quality, and prospective supplies and demand for wood products.

Forest economics - Analyze economic aspects of forestry practices on small ownerships and large public or private holdings. Provide guidance and support for industrial or public programs related to small forest enterprises.

Forest products marketing - Improve quality standards for buying and selling stumpage and primary forest products to improve income realized in marketing timber from farm or other small private forest tracts. Analyze economic aspects of transportation and marketing of forest products through cooperative arrangements of other means of improving net return from timber harvest on small forest properties and thus encourage better land use. Determine market potential in areas of unmarketable timber or residues to aid in strengthening local economies through increased use and development of their forest resources.

Construction of additional research laboratories and related facilities at many locations throughout the country is a significant and essential part of the Department's forestry research program.

State Land-Use Plans

A large number of land and water problems can be solved only by the full and joint use of the powers of both the Federal and State governments. Although the need for utilizing the powers and authorities available at all levels of government has long been recognized, progress in establishing arrangements for their effective use in managing land and water resources has been rather limited. There has been a trend to extend Federal programs directly to landowners through more or less nominal local and State organizations.

As we face the increasingly complex land and water use and mangement problems, it becomes more apparent that there should be greater cooperation between the Federal and State and local agencies. The States possess enormous powers and concomitant responsibilities in the direction and control of land and water resources. A way needs to be found to utilize these powers and responsibilities in resource management programs together with the extensive specialized technical skill and the vast financial resources of the Federal Government. The manner in which the Federal programs are administered can be used to develop strong incentives for State and local participation. Frequently there is too little responsibility required from the cooperating State and local organizations. Their

contributions often are little more than nominal and sometimes do not develop the help that should be expected from an interested partner or co-worker. Federal administrators could well pay more attention to the development of greater zeal through strengthening Federal, State, and local relations. Frequently, the sharing of responsibilities in program administration will produce large dividends. The various arrangements which the Department of Agriculture uses for local and State cooperation could be profitably reviewed and revitalized or modified as needs indicate.

A grant-in-aid program should be established to encourage States to prepare land and water plans that would supplement and advance USDA and other Federal programs. Included would be cooperative programs to develop improvements in water law and administration, stronger resource organization districts, rural planning and means of implementing the plans, land-use changes and the protection of developed areas, open space areas, transportation facilities, parks, wildlife areas, and other uses.

Several States have departments currently in operation that are effectively administering strong programs pertaining to planning and management of natural resources. All States should be encouraged and perhaps aided to do so. It is highly desirable that all Federal, State, and local resource use endeavors should fit into supplementing patterns. It is estimated that plans to enable Federal, State, and local resource programs to complement each other could be placed into operation at a small percent of the cost of the operating programs.

PART II

LAND AND WATER USE, POTENTIALS AND REQUIREMENTS

This Part presents a review of the land and water use situation, the trends in land and water use and land use by capability classes. Ownership and control of land resources and legal aspects of water use are also discussed. The probable growth of the economy in the next 20 years and the land requirements are estimated. The shifts between uses to bring about best land use and to meet requirements have been computed.

THE LAND AND WATER SITUATION

Our Use of Agricultural Land

Nearly one-fourth of the land in the 48 contiguous States is used as cropland. One-third is grassland pasture and range. One-third is in forest. If grassland and forest land used for grazing are included, about 75 percent of all land in the continental United States is in crop and livestock production. If all forest land is included, the area in agricultural use is 90 percent.

Alaska and Hawaii contain only slightly over one-half million acres of cropland, 3 million acres of grassland pasture and range, and 5 million acres of wild-land range which is in use or which is available for use. Most of the cropland area and improved pasture is in Hawaii.

Alaska has millions of acres of potential range, much of it of very limited year-long carrying capacity. Alaskan forests occupy 132 million acres. In Hawaii, 2 million acres are in forests.

Alaska's land resources are largely undeveloped. The land in crops, pasture, and range in the 50 States is 60 percent as compared to 75 percent in the 48 contiguous States (table 3).

Recent Trends

From 1954 to 1959 the cropland acreage in the continental United States declined by 8 million acres, or 2 percent. Cropland harvested declined about 6 percent.

Pasture improvement and development, including the seeding of cropland to pasture, accounted for a moderate increase in farm grassland pasture acreage. In some regions greater changes in cropland used for crops occurred than for the country as a whole. There were decreases generally in the East, with increases in the West. In the Central States the proportion remained unchanged.

Cropland acreage reached a peak from 1920 to 1930 with 480 million acres in that use. There was a decline of 13 million acres in cropland in the late 1930's with regain of 11 million acres in the 1940 war and post-war years. Since 1950, cropland acreage has dropped by 21 million acres to its lowest since 1910.

Table 3.- Land utilization: United States, 1959

Major use	48 contiguous States		All 50 States	
	Mil. acres 1/	Pct.	Mil. acres 1/	Pct.
Agricultural:				
Cropland	457	24	458	20
Used only for crops 2/	(391)	(21)	(392)	(17)
Used only for pasture	(66)	(3)	(66)	(3)
Pasture (excluding cropland pasture)	3/ 630	33	633	28
Forest land 4/	614	32	746	33
Commercial	(488)	(26)	(530)	(23)
Noncommercial	(126)	(6)	(216)	(10)
Farmsteads, farm roads	10	1	10	5/
Total agricultural land	1,711	90	1,847	81
Nonagricultural:				
Special-purpose uses	129	7	147	7
Urban and other built-up areas	6/ (53)	(3)	6/ (54)	(3)
Areas limited primarily to recreation or wildlife use	(47)	(2)	(62)	(3)
Forest land 4/	(25)	(1)	(27)	(1)
Nonforest	(22)	(1)	(35)	(2)
Public installations and facilities	(29)	(2)	(31)	(1)
Miscellaneous land	62	3	277	12
Total nonagricultural land	191	10	424	19
Total land area	1,902	100	2,271	100

1/ Acreages rounded to nearest million.

2/ Cropland harvested, crop failures, and cultivated summer fallow, soil improvement crops, and idle cropland.

3/ Open permanent pasture and range in the 48 contiguous States comprises 473 million acres and 157 million acres Federal grassland range used for grazing.

4/ Includes forested grazing land or range, including Federal forest range used by permit. The combined acreage of forest land including areas limited primarily to recreation or wildlife use (the 25 and 27 million acres shown under special purpose uses and embracing reserved forest land in parks, wildlife refuges, wilderness, and related areas) totals 639 and 773 million acres in the 48 and 50 States respectively.

5/ Less than 1 percent.

6/ Rounding to the nearest million accounts for part of the difference between totals for the 48 States and 50 States.

Grassland pasture and range were 22 million acres lower in 1959 than in 1930. Much of this change was to forest use and absorption by nonagricultural uses. Interchange between cropland and pasture has occurred in the good land areas. When field crops have been in unusual demand, cropland has increased. When demand has been low, cropland has tended to decrease, with part of the excess going into grassland pasture.

The conservation, crop allotment, and soil bank programs have helped to effect these shifts (table 4).

Although acreages in cropland, grassland pasture, and range have moved up or down by only a few percentage points since 1920, there have been marked changes among major uses. Foremost has been the improvement of land for crops and grassland pastures with drainage on too-wet lands, flood control, irrigation, and brush clearing.

Substantial shifts have been made between uses in some regions. Cropland has been concentrated on fertile and the more nearly level areas. Hilly and eroded land has been put in grass and trees. This shift of field crops to the better soil conditions has increased average yields.

In some areas the absorbing of farm acreage by urban, industrial, and communication developments is continuing at a rapid rate. Not only has this land been shifted to nonfarm uses, but fringe areas have been abandoned or lie only partly used as operators were drawn away by more attractive nonfarm employment.

From 1950 to 1960 approximately a million acres a year of agricultural land were required for nonagricultural uses, including urban expansion, highways, and airports.

Private lands, including Indian lands, comprise 72 percent of the land area of the 48 contiguous States and 61 percent of the land area of the 50 States. Most of the country's crop, pasture, and range production is from private lands (table 5).

Federally owned land makes up 34 percent of the land area. It is in timber and grazing uses and in mineral development. It is also used for recreational purposes, for watershed development, and for wildlife. The Federal lands constitute a reserve in timber, minerals, and water supplies.

Table 4.- Trends in major land uses, contiguous States, 1910-1959 1/

(Million acres)

Uses	1910	1920	1930	1940	1950	1959
Cropland used for crops 2/	347	402	413	399	409	391
Cropland used for pasture	84	78	67	68	69	66
Total cropland	431	480	480	467	478	457
Pasture and range 3/	693	652	652	650	631	630
Forest and woodland 4/	610	614	615	630	634	639
Other land 5/	169	157	156	158	161	176
Total land area 6/	1,903	1,903	1,903	1,905	1,904	1,902

1/ Acreages are for the 48 contiguous States exclusive of Alaska and Hawaii. For example, excluded in 1959 are the combined totals for Alaska and Hawaii of about one-half million acres of cropland, and 3 million acres of grassland pasture.

2/ Cropland harvested, crop failure, fallow, and idle cropland. Cropland and pasture use relates to the preceding years, except for 1959, where they are for the current year.

3/ Grassland pasture and other nonforest range land, excluding cropland used only for pasture. Includes idle grassland which probably existed in significant acreages only prior to 1920.

4/ Includes forest land in parks, wildlife refuges, wilderness areas, national defense sites, etc. Includes commercial and noncommercial forest land, and forest land grazed.

5/ Includes "special land use areas," such as urban areas, highways and roads, farmsteads, parks, game refuges, military reservations, etc., and also land having slight surface-use value except for wildlife, watersheds, and recreation (desert, rock, sand dunes, etc.). Special use areas make up about 60 percent of this acreage, the remainder being other miscellaneous areas.

6/ Remeasurement of the land area of the 48 contiguous United States in connection with the 1960 Census indicated an approximate land area of 1,902 million acres. The total land area of Alaska and Hawaii reported for 1960 was 369 million acres. Decreases in the total acres for the 48 contiguous States since 1940 chiefly represent increases in water area of large reservoirs.

Table 5.- Major classes of land by use and ownership, 1959

(Million acres)

Ownership	Cropland		Pasture and range		Forest		Special use and other land		Total	
	48 States	50 States	48 States	50 States	48 States	50 States	48 States	50 States	48 States	50 States
Federal	0.8	0.8	157.1	159.1	1/ 198.5	1/ 323.9	2/ 50.6	2/ 281.2	407.0	765.0
State and other public 3/	1.9	2.0	40.0	40.4	33.3	34.6	43.8	44.0	119.0	121.0
Private 4/	454.3	454.8	433.0	433.5	406.7	414.3	81.8	82.7	1,375.8	1,385.3
Total	457.0	457.6	630.1	633.0	638.5	772.8	176.2	407.9	1,901.8	2,271.3

1/ Includes reserved forest in parks and other special uses, and Indian forest.
2/ Excludes reserved forest in parks and other special uses which is included in Federal forest.
3/ Excludes State grant land in process of transfer from the Federal public domain to the State of Alaska.
4/ Includes Indian cropland, pasture and range, special uses, and other land.

Table 6.- Pasture and range, 1959 1/

(Million acres)

Item	48 States	50 States
By general ownership and classes of pasture and range:		
Private and other non-Federal land 2/		
Permanent grassland pasture and range 3/	473	474
Woodland and forest pasture 4/	160	161
Total private and other non-Federal land	633	635
Federal range 5/	240	242
Total	873	878
By principle vegetative cover types:		
Grassland pasture and range 6/	630	633
Woodland and forest pasture and range 7/	243	245
Total	873	878

1/ Preliminary tabulations for the 48 contiguous States from Conservation Needs Inventory and land use inventory projects.

2/ Private, Indian, State, and local government land, or non-Federal land.

3/ From Conservation Needs Inventory 1957-59. (Excludes about 9 million acres of wild hayland harvested for hay, included in cropland harvested acreage).

4/ Special estimates of non-Federal woodland and forest land pastured made by Conservation Needs Inventory technical workers.

5/ Federal range open and usable for grazing; compiled from records and reports of principle Federal land management agencies.

6/ Includes private and other non-Federal permanent grassland pasture and range; and Federal nonforest range.

7/ Includes an estimated 160 million acres of farm and other non-Federal woodland and forest pasture and range and approximately 83 million acres of Federal woodland and forest range in the 48 contiguous States.

Of the 765 million acres of federally owned land in the United States, 483 million acres (or 63 percent) is in forest and grazing use. The federally owned land is comprised of 714 million acres (or 94 percent) of public domain and 51 million acres (or 6 percent) which were acquired by purchase or other means. Nearly half the land in the public domain is in Alaska.

Land owned by State and local governments totaled 121 million acres or 5 percent of the land area in 1959. This included State parks, wildlife refuges, recreational areas, school-grant lands under lease or permit for farming and grazing, institutional lands, watersheds, and highway rights-of-way. Since transfer of Federal public-domain grants to Alaska had not been completed, an estimated 100 million acres in scheduled grants are included as Federal land (table 5).

Private and other non-Federal grassland pasture and range totals 474 million acres for the 50 States. An additional 161 million acres of private and other non-Federal woodland and forest are used for grazing.

Federal range totals 242 million acres, of which about one-third is in grassland or nonforested land. Two-thirds are woodland and forest. Thus, 878 million acres are in pasture and range. Of the total acreage, 633 million acres are grassland or nonforested land, and 245 million acres are in woodland and forest (table 6).

Land Capability Classes for Non-Federal, Nonurban Land 1/

Of the total non-Federal, nonurban land (1,450 million acres) slightly more than two-fifths, or 640 million acres, in land capability classes I, II, and III are suitable for regular cultivation. Of this, nearly three-fifths, or 370 million acres, are being cultivated (tables 7 and 8).

1/ Brief definitions of land capability classes are given on the following page and are discussed more fully in Agricultural Handbook No. 210. Acreage estimates are based on current interpretations. New technologies in agriculture in the future may modify these interpretations.

The Land Capability Classification

The capability classification is a practical grouping of soils. Soils and climate are considered together as they influence use, management, and production on the farm or ranch.

The classification contains two general divisions: (1) Land suited for cultivation and other uses, and (2) land limited in use and generally not suited for cultivation. Each of these broad divisions has four classes. The hazards and limitations in use increase as the class number increases. Class I has few hazards or limitations, or none, whereas class VIII has a great many.

Land suited for cultivation and other uses

CLASS I - These soils have few or no limitations or hazards. They may be used safely for cultivated crops, pasture, range, woodland, or wildlife.

CLASS II - These soils have few limitations or hazards. Simple conservation practices are needed when cultivated. They are suited to cultivated crops, pasture, range, woodland, or wildlife.

CLASS III - These soils have more limitations and hazards than those in class II. They require more difficult or complex conservation practices when cultivated. They are suited to cultivated crops, pasture, range, woodland, or wildlife.

CLASS IV - These soils have greater limitations and hazards than class III. Still more difficult or complex measures are needed when cultivated. They are suited to cultivated crops, pasture, range, woodland, or wildlife.

Land limited in use--generally not suited for cultivation

CLASS V - These soils have little or no erosion hazard but have other limitations that prevent normal tillage for cultivated crops. They are suited to pasture, range, woodland, wildlife, recreation, or water supply.

CLASS VI - These soils have severe limitations or hazards that make them generally unsuited for cultivation. They are suited largely to pasture, range, woodland, wildlife, recreation, or water supply.

CLASS VII - These soils have very severe limitations or hazards that make them generally unsuited for cultivation. They are suited to grazing, woodland, wildlife, recreation, or water supply.

CLASS VIII - These soils and land forms have limitations and hazards that prevent their use for cultivated crops, pasture, range, or woodland. They may be used for recreation, wildlife, or water supply.

Table 7.- Land capability classes by land use for 48 States for non-Federal, non-urban land 1/

(Thousand acres)

Class	Cropland	Pasture and range	Forest and woodland	Other	Total
I	32,315	6,931	3,891	1,511	44,648
II	189,494	46,867	41,506	11,452	289,319
III	147,394	67,400	75,129	15,174	305,097
I-III	369,203	121,198	120,526	28,137	639,064
IV	47,744	58,648	55,753	8,836	170,981
I-IV	416,947	179,846	176,279	36,973	810,045
V	1,794	11,516	28,294	2,161	43,765
VI	17,789	167,719	84,446	4,802	274,756
VII	5,210	140,283	140,545	8,819	294,857
VIII	63	3,382	7,092	16,530	27,067
V-VIII	24,856	322,900	260,377	32,312	640,445
Total	441,803	502,746	436,656	69,285	1,450,491

1/ Preliminary information from the National Inventory of Soil and Water Conservation Needs. September 1961.

The land use figures in this section of the report were obtained by different methods and by using slightly different definitions. Although the figures are not identical with those in other tables, the slight differences do not affect appreciably the comparisons that may be made.

Because of rounding to thousands, the total of items listed may not coincide with the total shown.

Table 8.- Land capability classes by land use for 50 States for non-Federal, nonurban land 1/

(Thousand acres)

Class	Cropland	Pasture and range	Forest and woodland	Other	Total
I	32,334	6,932	3,893	1,511	44,670
II	189,571	46,881	41,776	11,456	289,684
III	147,479	67,454	75,465	15,189	305,587
I-III	369,384	121,267	121,134	28,156	639,941
IV	47,828	58,726	56,060	8,846	171,460
I-IV	417,212	179,993	177,194	37,002	811,401
V	1,794	11,517	28,294	2,161	43,766
VI	17,824	167,947	84,995	4,893	275,659
VII	5,211	140,551	142,085	9,032	296,879
VIII	63	3,386	7,167	16,969	27,585
V-VIII	24,892	323,401	262,541	33,055	643,889
Total	442,104	503,394	439,735	70,057	1,455,290

1/ Data for Alaska are incomplete.

Preliminary information from the National Inventory of Soil and Water Conservation Needs. September 1961.

Because of rounding to thousands, the total of items listed may not coincide with the total shown.

About 240 million acres in classes I, II and III lands suitable for use as cropland are in pasture and woodland. Much of this acreage would be available, if needed, for crop production.

About 45 million acres is high quality class I land with a minimum of problems as far as erosion and continuing use are concerned. About three-fourths of this acreage is being cultivated. The 595 million acres in land classes II and III require moderate to intensive treatment for protection, improvement, and continuing production.

About 242 million of the 640 million acres suitable for regular cultivation require clearing, draining, or other improvement to fit the land for cultivation. A part of this land occurs in small or irregular areas which cannot be farmed efficiently with modern machinery. It would not be economically feasible in the foreseeable future to bring many of these small, irregularly shaped areas into cultivation. Operating farm units usually need a reasonable amount of pasture and woodlots, even on soils suitable for cultivation.

About 170 million acres of class IV land is suitable for limited or occasional cultivation with intensive conservation treatment. About one-fourth of this land is being cultivated.

About 25 million acres being used as cropland are unsuited for cultivation. This land is mainly in land capability classes V, VI, and VII.

Erosion is the dominant problem on 425 million acres, or about 60 percent of the land in classes II, III, and IV. In addition to the problem of the control of erosion on these acres, there are problems such as wetness in sloping soils with claypans, and drought in sandy soils. These conditions are often closely associated.

Excess water is a dominant problem on about 175 million acres in classes II, III, and IV. Unfavorable soil conditions add to the problem on about 125 million acres in these three classes.

Timber

Land in Timber Production

In the 50 States there are 530 million acres of commercial forest land. This, with 243 million acres of noncommercial forest land, comprises 11 percent of the total land area (table 9).

Table 9.- United States forest land area, 1959

Ownership	Commercial		Noncommercial		Total	
	Mil. acres	Pct.	Mil. acres	Pct.	Mil. acres	Pct.
Federal	139.1	26	184.8	76	323.9	42
Other public	27.6	5	7.0	3	34.6	4
Private	363.2	69	51.1	21	414.3	54
Total	529.9	100	242.9	100	772.8	100

About 639 million acres, or one-third of the 48 contiguous States, is forest land. Of that, 488 million acres is classed as being capable of producing timber and timber products (table 10). Much of Alaska and Hawaii is forested; however, only in Southeast Alaska do forests have significance as a timber resource.

Table 10.- Forest land area of the 48 contiguous States, 1959

Ownership	Commercial		Noncommercial		Total	
	Mil. acres	Pct.	Mil. acres	Pct.	Mil. acres	Pct.
Federal	99.5	20	99.0	66	198.5	31
Other public	27.3	6	6.0	4	33.3	5
Private	361.0	74	45.7	30	406.7	64
Total	487.8	100	150.7	100	638.5	100

The National Forests contain 85 million acres, or 67 percent, of the commercial forest land in public ownership.

Sawtimber

About 80 percent of the sawtimber inventory volume is in softwoods, mainly Douglas-fir, pine, hemlock, spruce, and fir. The southern pines are the only eastern species of the national significance among the softwoods.

The volume of sawtimber is about equal from lands in public and private ownership, although more than two-thirds of the total commercial forest land is privately owned.

About three-fourths of the Nation's total timber volume is in trees large enough to be manufactured into lumber. Sawlogs are by far the largest portion of the timber products harvested each year.

More than two-thirds of the sawtimber inventory is in the West, although three-fourths of the commercial forest land is in the East. This reflects the significance of both the heavy volumes per acre in western old-growth forests and in the young, poorly stocked stands of the East.

As the western old-growth is harvested and as eastern stands develop, softwood production will gradually shift to reflect more closely the location of the Nation's commercial forest land.

Characteristics of Timber Production

A unique aspect of growing timber as a crop is the amount of time required from seedling to harvest. This permits flexibility in choosing the time of harvest and in the variety of primary products obtainable. It offers the opportunity for a sustained yield through balanced growth and harvest.

Variations in species composition, size, stocking, quality, growth rates, and in damage from fire and pests are significant even among adjacent acres or tracts. Species composition is much more complex in the East. Ten to 15 commercially important species may occur on a small tract. Variation in quality, especially in hardwoods, may be wide. Values can range from unmerchantable trees to several hundred dollars per tree for high-grade veneer timber.

Private Forest Ownerships

More than half of the commercial forest land in the 48 contiguous States is in about 4.5 million individual ownerships. Of land in such ownership, 86 percent involves forest tracts of less than 100 acres. The average is 59 acres. About three-fourths of all small ownerships are on farms, and one-fifth of all farm acreage is forested.

Farm forest tracts average only 47 acres, but they comprise almost one-third of the Nation's commercial forest land. About 97 percent of these ownerships are in the East. The area controlled is nearly equal between North and South.

Production Problems

Productivity of forest land in farm and other small ownerships is below potential. Substandard stocking following harvest cutting is serious. These stands have the least protection from fire, insects, or other losses. Timber quality is uniformly poor.

Volumes per acre on these lands are below optimum growth conditions. Relatively few small forest properties are under the type of management necessary to produce efficiently. The southern region, in general, offers exceptional opportunity for improvement in the production of timber on small holdings.

Future Timber Supplies

It is clear that most forests need improved management in order to realize full growth potential. Inventories must be adjusted to provide the growing "capital" to meet specific future needs. Growth must be stimulated to ensure adequate volumes in the various qualities and quantities of raw materials that will be required.

A major problem in the East is to maintain softwood on softwood sites in the face of invasion by undesirable hardwood species. Another problem is reflected by the downward trend in hardwood quality.

One-fourth of the Nation's commercial forest land is poorly stocked, and almost half is nonstocked. It will require planting to be restored to productivity within a reasonable time. Natural regeneration and improved protection and management practices may alleviate this problem gradually.

Annual losses from disease, insects, and fire are equal to current net growth. This rate of loss must be decreased significantly in order to meet future needs.

Some losses, such as the mortality of affected trees, are direct. Greater losses result from the slowing of growth rates and from decay or damage to wood otherwise useful.

Improved practices are needed on millions of acres to improve the growth rate and quality of timber production. Removal of cull and defective trees, release from competing vegetation, and pruning and thinning of immature stands are among the measures needed. Harvesting to improve the growing stock volume and quality, rather than to exploit it, is essential.

As much as one-fourth of the timber cut is not utilized, although improved technology and marketing can be expected to eliminate much of this waste. Most of these unused residues are associated with sawlog harvesting and lumber manufacture.

Pasture and Range

Grazing is the largest single use of agricultural land.

The gross income to farmers from cattle and sheep in 1960 was over $12.5 billion. Pasture and range provide about one-third of all feed used by livestock.

About 10 million head of deer, elk, and antelope also obtain forage on ranges and pastures. In addition, these lands are important as watersheds, for wildlife habitat, and for recreation.

Nearly 245 million acres of forests and woodlands are grazed.

The 878 million acres of permanent pasture and range comprise the largest portion of the Nation's grazing resources. About 70 percent is privately owned and 4 percent is State owned. Eight percent is administered by the Forest Service, 14 percent by the Bureau of Land Management, and 4 percent is under direction of the Bureau of Indian Affairs.

Domestic livestock graze 66 million acres of cropland which is used only for pasture.

The Status of Ranges and Pastures

Ranges in good condition can be improved 25 to 50 percent, those in fair condition can be improved 50 to 75 percent, and those in poor condition can be improved 75 percent or more (table 11).

Table 11.- Percentage of privately owned range in each range condition class

Region	Excellent	Good	Fair	Poor
	Percent	Percent	Percent	Percent
Western	5	15	30	50
Southern Great Plains	5	15	40	40
Northern Great Plains	10	20	40	30
Southeastern	5	10	50	35

Present range condition and forage production on publicly owned rangelands are, on the average, only half or less of their potential. They fall short of the demands for livestock and game grazing.

Vast areas, particularly in the western mountains, have been damaged to the point that flood and sediment hazards have been increased and both the availability and the quality of water produced is affected.

Conservation management is a pressing need if the production potential of tame pastures is to be realized. Fertilization and proper use are the most neglected pasture practices.

Range site and condition surveys have been made on 125 million acres of privately owned rangelands. The owners of these rangelands, as cooperators with soil conservation districts, have developed basic conservation plans. Such a plan includes: (1) A conservation plan map which contains information on ownership boundaries and range site and condition; and (2) the cooperator's decisions as to what treatments he intends to use in improving and conserving grazing and other resources.

Range site and condition surveys are being completed at the rate of 15 million acres a year.

Similar range condition and trend surveys and subsequent management planning have been completed on 45 percent of the rangeland administered by the Bureau of Land Management, Forest Service, and Bureau of Indian Affairs. At present rates, all of these lands will be covered by surveys within 5 years.

Noxious Plant Infestation

Grazing on some 240 million acres of rangelands, much of it west of the 100th Meridian, has been severely reduced by the invasion or increase of low-value trees and shrubs, such as mesquite, juniper, sagebrush and oak. Such increases are generally accompanied by accelerated erosion.

Outdoor Recreation

Interest in outdoor recreation in the last 15 years has far outstripped population trends and most other growth indicators. The variety of outdoor recreation activities also has increased.

Recreational visits to the National Forests have increased tenfold since 1945. Visitors exceeded 100 million in 1961. The number of annual recreation visits to National Parks, National Forests, and to State parks probably will reach 600 million by 1970.

Camping, picnicking, swimming, boating, hunting, fishing, and sightseeing remain the principal uses of outdoor recreation resources. In addition, people are skiing, skindiving, waterskiing, hiking, and mountain climbing in increasing numbers.

Factors such as more leisure, more disposable income, and improved roads and automobiles account at least in part for this increase in outdoor recreation.

Recreation and Other Land Uses

The Nation's forests, waters, and diverse topography form a most valuable basic resource for outdoor recreation.

The impact of recreational use upon other major uses is relatively minor. Pheasants can be hunted in cornfields, fish can be caught in reservoirs, and hikers may camp in the forest without interrupting or conflicting with other uses of such areas. Even areas which have been set aside for recreational use such as National or State parks have important watershed and wildlife values.

All Ownerships are Involved in Outdoor Recreation

Public and private lands share in providing the land, forest, and water environment for outdoor recreation.

Traditionally, hunting, fishing, and hiking have been regarded as pursuits which may be rightfully enjoyed by all rather than as privileges acquired by wealth, landownership, or governmental fiat. Farmers, industrial owners, and government agencies have, for the most part, honored that tradition. The result is that these forms of outdoor recreation are still generally unrestricted, although there is a growing tendency to prohibit public hunting on private tracts.

On many millions of acres in Federal ownership, such as the National Forests and the public domain, outdoor recreation is recognized and provided for as a primary use of land. Many State and local governments have established and developed parks and other areas to help meet the demand for outdoor recreation. Most forest industries have made their land available for recreation use and in some cases have even provided facilities. Farmers usually have granted permission to hunt or fish on their property.

Water Recreation

Much recreation is water-oriented. Boating, waterskiing, skin-diving, swimming, and fishing are fast-growing outdoor sports. Recreational visits to reservoirs supervised by the U. S. Corps of Engineers were estimated at more than 100 million in 1960. In the same year, recreational use of National Forests, National Parks, and State parks was more than four times that amount. Reservoirs built in connection with watershed projects are providing additional recreational opportunities. Recreationists are also making fuller use of the great natural water resources represented by the Nation's seashores, streams, lakes, rivers, and other natural waters.

Forest Recreation

Forests are usually associated with rugged topography, scenic beauty, diverse vegetation, lakes, streams, and other natural features. They are the native habitat of upland game, and thus have a special value in the enjoyment of wildlife and in hunting. The streams in the Nation's forested watersheds provide fishing enthusiasts with much of their sport.

Open-Land Recreation

Nonforested areas include mountain tops, wastelands, and desert. These have unique recreational values. Many of the Nation's striking scenic areas are primarily of this type. The Grand Canyon, the Badlands of South Dakota, and snow-covered Mt. Rainier are examples.

Rangelands, too, are important in the outdoor recreation scene. Large- and small-game hunting, horseback riding, and wilderness trips are based to a large degree upon recreational use of open land.

Outdoor Recreation Problems

The increasing use of outdoor recreational resources calls for vigorous preparation for still greater demands. There is no sign of slackening in the rate of increase in recreational use of lands, forests, and waters.

On public lands, many facilities constructed in the 1930's need to be replaced, rehabilitated, and supplemented. Private recreation lands and facilities will receive increasing use. Additional public and private land must be available in suitable quantities and kinds to meet needs as they arise.

Use conflicts between competing recreationists and, to a lesser degree, conflicts between recreationists and other users of land, forest, and water resources, need to be reconciled. These problems arise in part from overcrowding, inadequate facilities, and the difficulty sometimes encountered in regulating outdoor recreation.

Wildlife

Animals, birds, and fish are products of land, forest, and water. The wildlife resource is associated closely with outdoor recreation. Between 1955 and 1960, the number of hunters and fishermen increased by 20 percent; and their activities generated economic values from the manufacture and sale of sporting goods and the provision of other related services. Tourists, photographers, and students of nature are stimulated by a desire to observe wildlife; the values gained are difficult to assess.

Fortunately, the continued existence of wildlife populations is assured by the efforts of dedicated citizens, State fish and game agencies, and by the sympathetic administration of public lands, forests, and waters.

Sport Fishing

Sport fishermen spent over $50 million for more than 20 million fishing licenses in 1959. In 1960, about one-fourth of the men and one-tenth of the women in the Nation were enjoying the sport.

Management of game fish populations is the subject of research and public interest. Federal and State fish hatcheries produce millions of fingerlings and larger fish, and many streams are stocked and fished on a "put and take" basis.

Mounting threats to fish populations are stream pollution and the destruction of fish habitat.

Game Animals and Birds

One in every five male citizens hunted in 1960. Exclusive of waterfowl hunters, about two-thirds of the Nation's hunters are searching for small game. One-third hunt big game.

Although large numbers of animals are harvested each year, it is generally agreed that hunting pressure is seldom the limiting factor on game populations. Food, cover, weather, and natural cycles are much more significant.

Game populations--especially big game--may create special management problems when their numbers increase beyond the normal carrying capacity of their habitat. For example, browsing by too many white-tailed deer in forests may prevent establishment and development of young trees needed for future timber crops.

Control of destructive insect populations by birds has economic importance. In addition, both upland birds and migratory waterfowl are mainstays in public hunting. Birds are also valued for their recreational and esthetic qualities.

Destruction of habitat is a problem facing migratory bird populations today. Measures to preserve in public ownership key areas used by migratory waterfowl, and to encourage development of wetland habitats on private land are logical steps in preserving this resource. More effective and economic methods and materials for control of crop and forest insects and diseases, with minimal hazards for birds, bees, and fish, are needed.

Public Lands and Wildlife

Most public lands and forests are managed in recognition of wildlife values. In addition, there are about 29 million acres in Federal and State wildlife refuges managed to protect and improve wildlife populations.

Hunting and fishing regulations on public lands usually are set by the State concerned. Management of Federal lands and forests is toward improvement of food and cover to support large and vigorous wildlife populations.

Wildlife on Private Lands

Farms and ranches provide a great variety in cover and food supply for many kinds of wildlife. The private lands, because of their extent and variety, hold the major potential for meeting future wildlife conservation and production needs. About 85 percent of the wildlife habitat which may feasibly be improved and from which 80 percent of the game may be taken by hunters is on private land.

Private landowners, especially farmers and ranchers, therefore, are principal custodians of the Nation's wildlife habitat. The upward trend in general wildlife abundance, notwithstanding certain exceptions, demonstrates that agriculture and wildlife are interdependent and basically harmonious. A wide range of conservation practices on forest, pasture, and cropland--such as windbreaks, farm ponds, and wildlife area improvements--benefit wildlife substantially.

Rising Pressures on Wildlife Resources

Growing pressures upon wildlife populations and their habitat requires sound management of this valuable national resource. Although problems are numerous, and many will be difficult to solve, it seems likely that concerted efforts can maintain this resource adequately and even strengthen it. Extension of existing programs such as farm pond development, fish hatchery production, research, introduction of suitable exotic species, abatement of water pollution, and similar efforts will do much to meet future needs and solve current problems. Progress must also be made in fields such as landowner compensation, public support of sound management of big-game populations, and in reduction of wildlife damage to other resources.

Of the many species of fish and game, some require relatively little special assistance while others may need drastic efforts to ensure survival.

All in all, wildlife populations represent one of the many renewable natural resources currently under increasing pressures and clearly destined to receive even greater pressures in the future. Use and management of this resource, like the others, must be improved and strengthened if the needs of future generations are to be met adequately.

Multiple Uses

When increasing numbers of people must rely on an unchanging or diminishing resource base, they must strive for the most effective use of the resources they have. Multiple use of renewable land resources thus is a necessity.

Competition for Land

The expansion of cities and towns, the building of highways, airports, transmission lines for electrical power, pipelines for oil and natural gas, and construction of dams and reservoirs each

year requires large acreages of agricultural land. Withdrawals of land for national defense purposes are likely to continue. Tremendous pressures are developing for the reservation of more forest lands exclusively for recreation.

In some of these uses--such as for super-highways--the land must be in such use exclusively. Problems arise where uses of equal importance are incompatible. As competition for use of land increases, so does the need increase for more intensive use of land and the need for putting the land to more than one use.

Multiple-Use Management

Multiple use is already the guiding principle of management of large areas of public and private lands. The City of Los Angeles permits limited oil extraction along beaches, on golf courses, and in one residential area. Pumps are underground; the surface is landscaped.

Soil and water conservation on farms has produced fertile croplands, quality forage for cattle, and suitable habitat for small game animals and birds. Stocking of cattle ponds with fish and the planting of game cover and foods along fences have made possible a variety of uses.

Timber, water, wildlife habitat, forage, and recreation may occur as joint products of the same tract of forest land. The National Forests are managed for outdoor recreation, range, timber, watershed, and wildlife and fish purposes. Such lands are also available for development of mineral resources.

Farm Land Tenure

Ninety-three percent of all land in farms, excluding public land under grazing permits, is privately owned. The use of this land is decided largely by individuals who own and operate the land in their own interest.

From 1940 to 1959, the tenure pattern has been marked by an increase in part owners from 10 to 22 percent, with a decrease in full tenants from 39 to 20 percent (table 12). The proportion of full-owner operators has been relatively steady; since 1950 it has been unchanged, at 57 percent. Owner-operators, which includes full owners and part owners, increased from 61 percent in 1940 to 79 percent in 1959. The proportion of land operated by owner-operators has increased also, from 64 percent in 1940 to 75 percent in 1954. Since 1950, more than half of the owner-operated land has been operated by part owners.

Table 12.- Number and percentage distribution of farms and land in farms, by tenure of operator, United States, selected years, 1940 to 1959

Tenure of operator	1940	1950	1954	1959 1/
	Farms			
	Number	Number	Number	Number
All farm operators	6,096,799	5,382,162	4,783,021	3,703,642
Full owners	3,084,138	3,089,583	2,744,708	2,116,026
Part owners	615,039	824,923	868,180	809,600
Managers	36,351	23,527	20,894	20,503
All tenants	2,361,271	1,444,129	1,149,239	757,513
	Farms			
	Percent	Percent	Percent	Percent
Full owners	50.6	57.4	57.4	57.1
Part owners	10.1	15.3	18.2	21.9
Managers	.6	.5	.4	.6
All tenants	38.7	26.8	24.0	20.4
	Land in farms			
	Percent	Percent	Percent	Percent
Full owners	36.0	36.2	34.2	2/ 31.0
Part owners	28.3	36.5	40.7	2/ 44.4
Managers	6.3	9.1	8.6	2/ 9.8
All tenants	29.4	18.3	16.4	2/ 14.8

1/ Preliminary.
2/ Estimated for this report from preliminary unofficial information.

Source: U. S. Bureau of the Census, Census of Agriculture.

There has been little change in the proportion of all land rented. Renting by part owners has tended to replace renting by full tenants. Part owners now outnumber and operate more rented land than do tenants. In 1950 and again in 1954, 35 percent of all land in farms was rented mostly from nonfarmers. In 1954, 406 million acres of the 1,160 million acres of land in farms was rented by farm operators. Of this, 348 million acres was rented from nonfarmers, and 58 million acres was owned by farm operators who rented it to other operators.

Ownership of farmland is chiefly by farmers. A 1946 study of landownership found that 82 percent of all landowners operated some or all of their land. They owned 78 percent of all farmland in the United States. Regional variation in the relative proportions of both owner- and nonowner-operators and acreage owned was pronounced in some instances. The extremes were the North Central and Northeastern regions. Three times as many landowners in the North Central region were nonoperators as in the Northeast region.

Recent studies of landownership in the Southeast and Great Plains regions, and in Iowa, show a wide variation in the proportion of operators among landowners and in the relative acreage owned by operators and nonoperators. In the Great Plains, 74 percent of all landowners operated some or all of their land. They owned 80 percent of the farmland in the 10 States. In contrast, operators in Iowa made up 52 percent of all owners and they owned 48 percent of the farmland. The Southeastern States showed slightly higher owner-operatorship than the Great Plains. These data pertain only to land classed as farm or ranch and, although they include some forest land, generally do not include the larger tracts of land held for commercial forestry and other nonfarm uses.

Tenure Adaptations

Significant changes in the tenure structure of agriculture have resulted from adaptation of existing tenure arrangements and use of new arrangements to accommodate the trend to fewer and larger farms. Farmers increasingly have had to rely on means other than ownership to acquire resources needed for larger operation. Some means of acquiring additional resources are of sufficient importance in terms of the number of farm operators or the total resources involved that they may lead to important structural changes.

Part Ownership.- Renting is a leading source of capital for many farmers. In 1959, 42 percent of all farmers rented part or all of the land they operated (table 12). The value of the real estate they rented amounted to $45.6 billion. This rented real estate was 36 percent of the total value of all farm real estate. 2/

The increase in part owners and corresponding decrease in full tenants in recent years indicates that the traditional concept of leasing as an early and perhaps less desirable tenure status has changed. Over half of all rented land is operated by part owners who, on the average, have achieved a larger scale of operation than either full tenants or full owners. In 1959, preliminary estimates show that the average part-owner farms contained 614 acres, full-owner farms 164 acres, and tenant farms 220 acres. Part owners operate almost as much land as full owners and tenants combined.

Vertical Integration.- Contract farming and vertical integration have increased in importance in recent years. This is especially noticeable for such products as broilers, where a high degree of production specialization is feasible. This device for obtaining additional resources, particularly capital and assistance in management and marketing, has caused concern about effects on the structure of farm tenure. Much of this concern is related to the possible loss of control over resource use by farmers.

The total impact of vertical integration upon resource ownership and use has not been determined. However, there is reason to believe that production and marketing decisions for several commodities may presently be quite centralized. It is estimated that about 95 percent of the commercial broiler production is on some type of integrated basis; most western citrus growers participate in an integrated system of production and marketing; about 90 percent of the vegetables produced for canning and freezing are grown by or under contract to processors; about 35 to 40 percent of the potato production is handled under a grower-shipper arrangement; and about 75 percent of the hybrid seed corn production is under some form of vertical integration. 3/

2/ The Balance Sheet of Agriculture, 1959, ARS, U. S. Department of Agriculture, AIB 214, table 8.

3/ Contract Farming and Vertical Integration in Agriculture, AIB 198, U. S. Department of Agriculture, July 1958.

Farm Incorporation.- Recent revisions in the Internal Revenue Code have removed many impediments to the incorporation of farms. The law now provides that certain small, closely held corporations may elect to be taxed as partnerships. Earnings of those corporations that meet the necessary requirements are taxed only as income of the individual shareholders and not as income of the corporation.

There are at present about 7,500 corporations engaged primarily in farming. Although the full impact of the changes in the Internal Revenue Code is not known, farm incorporation in several States increased greatly after passage of the law.

Other well-known advantages of a corporate organization are limited liability, perpetual life, and improved financing opportunities. But these advantages, as well as the tax-saving opportunity, are likely to be slight for most small- and medium-sized family-operated farms in relation to the problems involved in incorporating.

The potential for farm incorporation far exceeds the number actually incorporated. In 1959, there were 312 thousand farms with sales of $20,000 or more, of which 102 thousand had sales of $40,000 or more. Although these farms operate under a wide range of circumstances, it is likely that many of them could obtain other advantages from incorporation.

Partnerships.- The Internal Revenue Service estimates that about 131,000 farms are taxed as partnerships. In view of the high capital requirements for most types of adequately sized farms, there are compelling reasons for farm operators to seek means for acquiring additional resources and thereby obtaining the efficiencies of larger size. Even so, the unlimited liability feature and other disadvantages of most legal partnerships tend to discourage their wide use.

Other arrangements close to a partnership in operation but without its legal features are various kinship operating arrangements and some lease arrangements, notably livestock-share leases. Not all are undertaken for the express purpose of accumulating larger resources. Kinship operating arrangements sometimes have as a major purpose the transfer of property between generations with a minimum disruption of farm operations. In contrast, livestock-share rented farms may retain much of the same livestock herd over a period of years and yet change tenants from time to time. Except on farms operated by a close relative of the landlord, farm transfer is usually not an aspect of the basic lease agreement.

The landlord's heavy financial participation in non-real estate production items, relative to most other types of leases, is often the means whereby his active participation in the farm operation is reduced yet his investment and income are maintained. From the standpoint of a tenant, the high capital investment and the risk involved in herd ownership under the customary 1-year lease may discourage efforts to go into livestock production without participation by the landlord in addition to providing real estate. Thus the near-partnership feature of many livestock-share leases can be advantageous, particularly in areas not well suited for cash-crop farming or in areas where the market advantage of a livestock operation is much superior to other types of production.

Purchase by Land Contract.- Because of competition for rental land, farmers who might otherwise have sought to rent land may buy it. Of several means of financing land purchases, conventional mortgage financing is the most common. However, the use of land contracts to finance land transfers has increased substantially in recent years.

Nationwide, about 20 percent of all landownership transfers are now financed by land contracts, probably twice as many as in 1946 and 1947. 4/ Their use is greatest in seller-financed transfers. At present, 43 percent of all farmland transfers are financed by the seller. More than two-thirds of these transfers are by land contracts. 5/

Under a typical land contract, the buyer makes only a small down payment or none, borrows no money, and does not obtain title to the land until a specified amount of the debt has been paid. If he defaults before this amount is paid, the full amount of the contract may become due and he may lose his equity, depending on the terms of the contract and State laws covering purchase contracts.

4/ Paul L. Holm, "Financing Farmland Transfers," Agricultural Finance Review, Vol. 21, July 1959, ARS, U. S. Department of Agriculture, Washington 25, D.C.

5/ Current Developments in the Farm Real Estate Market, ERS-59, Oct. 1961, U. S. Department of Agriculture, Washington 25, D.C.

Rising land prices and high farm incomes, which have protected buyers from much of the risk inherent in such sales in recent years, have undoubtedly contributed to the increase in this type of transfer. Sellers also have had an incentive to sell land under purchase contracts through the tax advantages obtained if a transfer qualifies as an installment sale; i.e., if the total payment received in the year in which the property is sold does not exceed 30 percent of the purchase price. These factors, plus competition for land to enlarge farms, give rise to a situation in which low-equity financing of land purchase is increasingly attractive.

Farm Size Changes

From 1954 to 1959, the total number of farms declined from about 4.8 to 3.7 million, a drop of 23 percent (figure 1). A little more than a fifth of the decline can be accounted for by a change in the definition of a farm whereby 232 thousand units, most of them under 10 acres in size, are not counted as farms. Only farms in the size classes 500 to 999 acres and 1,000 acres and over showed an increase (table 13). The addition of each farm of 500 acres and over in the period 1954 to 1959 was accompanied by a disappearance of 77 farms smaller than 500 acres.

Table 13.- Number and percentage distribution of farms, by size of farm, 1954 and 1959, and change from 1954 to 1959

Size of farm	Farms					
	1954		1959		Change from 1954 to 1959 1/	
	No.	Pct.	No.	Pct.	No.	Pct.
Under 50 acres	1,697,122	35.5	1,051,810	28.4	-645,312	-38.0
50 - 99 acres	864,063	18.0	657,651	17.8	-206,412	-23.9
100 - 259 acres	1,416,807	29.7	1,186,583	32.0	-230,224	-16.2
260 - 499 acres	482,246	10.1	471,382	12.7	- 10,864	- 2.2
500 - 999 acres	191,697	4.0	199,957	5.4	+ 8,260	+ 4.3
1,000 or more acres	130,481	2.7	136,259	3.7	+ 5,778	+ 4.4
Total	4,782,416	100.0	3,703,642	100.0	-1,078,774	-22.6

1/ 231,862 farms were excluded in 1959 by a change in the definition of a farm.

Source: U. S. Bureau of the Census, Census of Agriculture.

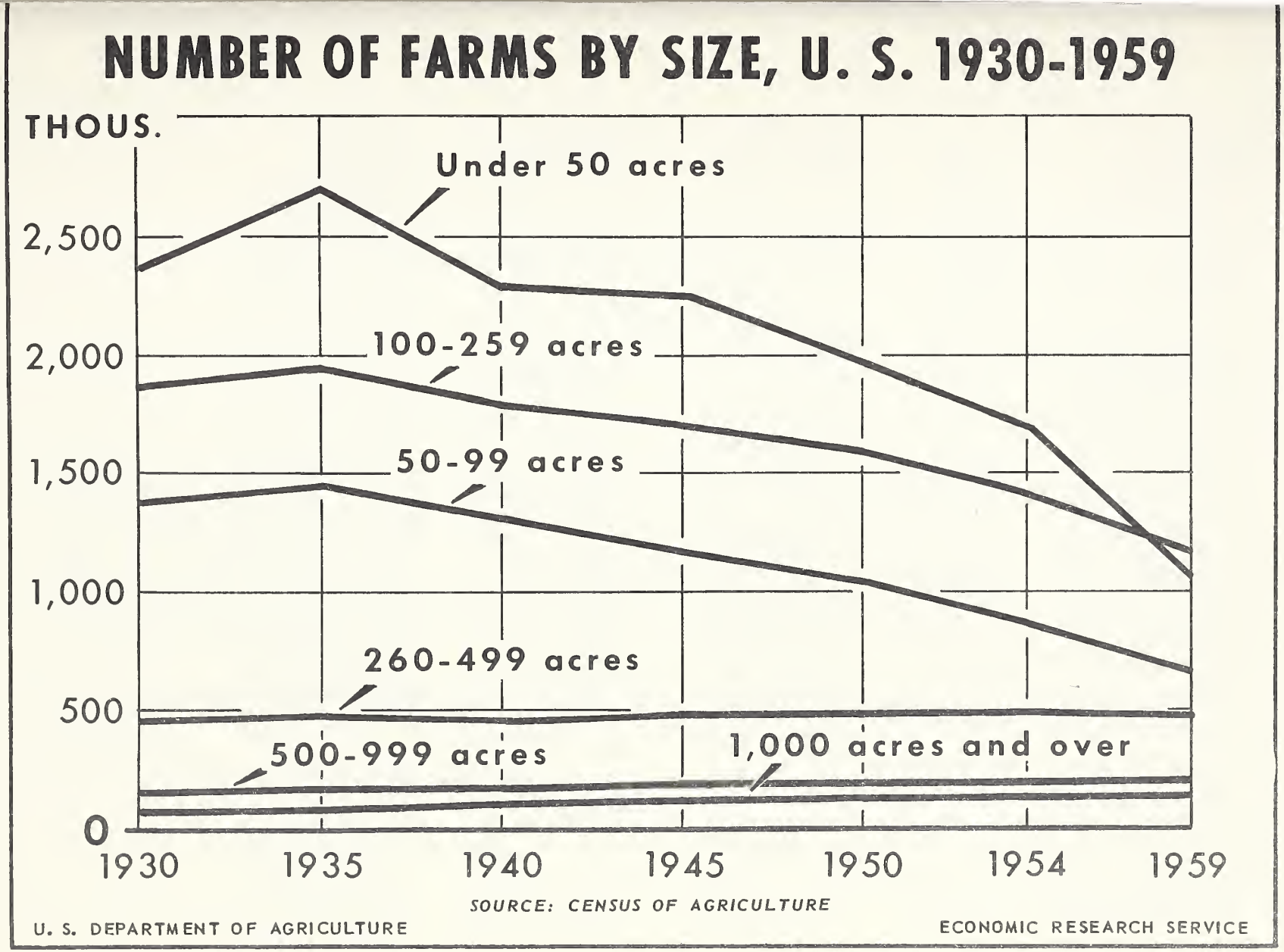

NUMBER OF FARMS BY SIZE, U. S. 1930-1959
THOUS.
Under 50 acres
100-259 acres
50-99 acres
260-499 acres
500-999 acres
1,000 acres and over
2,500
2,000
1,500
1,000
500
0
1930
1935
1940
1945
1950
1954
1959
SOURCE: CENSUS OF AGRICULTURE
U. S. DEPARTMENT OF AGRICULTURE
ECONOMIC RESEARCH SERVICE

Figure 1

There has been a gradual increase in the proportion of farmland in larger farms. The proportion of land contained in farms of over 1,000 acres increased from about a third to a half during the years 1940 to 1959 (table 14), while farms of 500 to 999 acres increased from 11 to 12 percent. The proportion of farms under 260 acres and amount of land they included decreased sharply (table 14). The number of farms of 260 to 499 acres decreased by 2 percent from 1954 to 1959; they show little change since 1940 in the proportion of land operated.

The regional pattern varies. Large farms are concentrated mainly in the Great Plains, West, and Cornbelt. Farm disappearance has been heaviest in the South, corresponding to the sharp decline in sharecroppers and tenants and the large-scale shift of land from farming to other uses, such as forestry.

The trend toward fewer and larger farms is seen also in the increase of farms with $10,000 or more in farm product sales. From 1954 to 1959, the number of these farms increased from about a fifth to a third of all commercial farms (table 15). While in 1954 only 18 percent had product sales of $10,000 or more, in 1959, 20 percent had sales of $10,000 to $20,000 and 13 percent had $20,000 or more. There was a 72 percent decline in farms with less than $2,500 in sales. Price levels were roughly comparable in the two periods.

Noncommercial farms, including part-time, residential, and abnormal farms have also declined in numbers, although they increased, proportionately, between 1954 and 1959 from 30 to 35 percent of all farms. The total land area of these farms amounted to 127.6 million acres in 1954, 11 percent of the total. A little less than a third of this land was in 2,700 abnormal farms, averaging 14,500 acres in size; the remainder was in 1.45 million part-time and residential farms averaging 81 and 48 acres, respectively.

A lower limit of $10,000 in farm sales is sometimes taken as a minimum needed to obtain a net income of $2,500. According to this, considerable improvement is seen in the economic position of farms. Yet the capital investment needed to achieve this scale of operation varies widely between areas and types of farms. Of 11 major types of farms, average investment in the period 1950-59 of farms with $2,500 net farm family income ranged from $12,000 for peanut-cotton farms in the Southern Coastal Plains to $124,000 for

Table 14. - Percentage of farms and land in farms, by size of farm, 48 contiguous States, 1940-1959

(Percent)

Size of farm	1940		1945		1950		1954		1959	
	Farms	Land	Farms	Land	Farms	Land	Farms	Land	Farms	Land 1/
Under 50 acres	37.5	4.7	38.3	4.1	36.5	3.6	35.4	3.0	28.4	1.9
50 - 99 acres	21.2	8.8	19.8	7.3	19.4	6.5	18.0	5.4	17.8	4.2
100 - 259 acres	29.5	26.5	28.9	23.5	29.5	22.0	29.7	19.8	32.0	17.2
260 - 499 acres	7.5	15.0	8.1	14.4	8.9	14.4	10.1	14.5	12.7	14.7
500 - 999 acres	2.7	10.6	3.0	10.4	3.4	10.9	4.0	11.4	5.4	12.3
1,000 or more acres	1.6	34.3	1.9	40.3	2.3	42.6	2.7	45.9	3.7	49.7

1/ Estimated.

Table 15. - Commercial farms by value of farm products sold, United States, 1954-1959

Value of farm products sold (Dollars)	1954		Value of farm products sold (Dollars)	1959	
	Farms	Distribution		Farms	Distribution
	Number	Percent		Number	Percent
10,000 or more	582,948	18	10,000 or more	794,001	33
Less than 10,000	2,744,669	82	Less than 10,000	1,618,159	67
Total	3,327,617	100	Total	2,412,160	100
25,000 or more	134,003	4	40,000 or more	102,143	4
10,000 to 24,999	448,945	14	20,000 to 39,999	209,974	9
			10,000 to 19,999	481,884	20
5,000 to 9,999	706,929	21	5,000 to 9,999	652,938	27
2,500 to 4,999	811,965	24	2,500 to 4,999	616,839	26
Less than 2,500	1,225,775	37	Less than 2,500	1/ 348,382	14
Total	3,327,617	100	Total	2,412,160	100

1/ Due to the change in definition, 232,000 fewer farms were reported in 1959.

Source: U. S. Bureau of the Census, Census of Agriculture.

winter-wheat farms in the Southern Plains. 6/ The land investment in the two cases cited amounts to 70 percent and 80 percent, respectively, of total farm investment. Nationwide, 80 percent of the total farm investment is in real estate. 7/

These trends raise some serious problems about the future tenure structure of American agriculture. In view of the impact of technology on farm size, and capital and managerial requirements, programs are needed to further the objectives of family operation and access to farming opportunities.

Water Uses

Good-quality water is becoming increasingly scarce in many areas. Unless existing surface and subsurface supplies are managed efficiently and fully developed, the Nation's potential for economic growth will be limited. Converting saline water to fresh water may hold promise for relieving undersupply to a degree, but such efforts much be supplemental to sound programs aimed at conserving and developing surface and ground water resources through watershed management, streamflow regulation, and full economic use.

Available Ground and Surface Supplies

Precipitation may be evaporated or transpired at or in the vicinity of its point of contact, may recharge underground aquifers, or it may appear as streamflow (table 16).

Much of the 70-percent portion of precipitation never reaching streams replenishes ground water supplies and sustains vast acreages of forests, grasslands, and nonirrigated crops and pastures.

6/ Brewster and Wunderlich, "Farm Size, Capital, and Tenure," in Adjustments in Agriculture - A National Basebook. Estimates based on data from U. S. Dept. Agr., Agr. Inform. Bul. 176, 1959, Farm Costs and Returns, Commercial Family-Operated Farms by Type and Location.

7/ Ibid.

Table 16.- Estimated current water supplies in the United States, excluding Alaska and Hawaii 1/

Supply item	Millions of acre-feet	Equivalent inches per unit-area	Percent of precipitation
Annual precipitation supply 1/	4,394	27.7	100
Annual on-site use 2/	3,068	19.4	70
Annual runoff or streamflow supply 3/	1,326	8.3	30
Total ground water stock 4/	43,960	277.1	--
Ground water as years of runoff	33 years	--	--

1/ Unless otherwise indicated, data are from the U. S. Senate Select Committee on National Water Resources, 86th Cong., 2nd sess., Committee Print No. 13, Estimated Water Requirements for Agricultural Purposes and Their Effects on Water Supplies, Washington, D. C., Govt. Print. Off., 1960, p. 18.

2/ Includes direct evapotranspiration in forest and nonirrigated agricultural crop production, livestock production, ground water recharge in upstream areas, and other upstream uses.

3/ Supply available for downstream withdrawal or nonwithdrawal uses at points below at least a 1,000-square mile drainage area.

4/ It is estimated that the total quantity of ground water of the 48 States is roughly equivalent to 10 times the average annual volume of precipitation and 35 times the average annual volume of runoff over the country. The lesser estimate of 10 times the average precipitation is given above as 43,960 million acre-feet. See: A. M. Piper, "The Nationwide Water Situation," The Physical and Economic Foundation of Natural Resources: IV, Subsurface Facilities of Water Management and Patterns of Supply, House of Representatives Interior and Insular Affairs Committee, Washington, D. C., Govt. Print. Off., 1953, p. 15.

Nonirrigated crops account for roughly 80 percent of the total value of crop production in the United States. Livestock and timber production is virtually all on nonirrigated land. This indicates that managing all forms of vegetative cover and their supporting landscapes is important in dealing with the Nation's water problems.

Withdrawal and Consumption of Existing Supplies

Major water withdrawals in the 48 States from streamflow and ground water are increasing (table 17). In 1960, they totaled 338 million acre-feet per year, or 300 billion gallons daily.

Rural areas now use 135 million acre-feet, or 40 percent of all withdrawals, for livestock, household, and irrigation. The declining importance of agricultural withdrawals relative to other uses is indicated by lower rates of increase for agriculture by 5-year periods since 1940, with the exception of the period 1945-50.

Annual consumption of water from streams and wells for all purposes amounts to 94 million acre-feet, or 28 percent of that withdrawn.

Largely because of a 60-percent consumptive use rate in irrigation, diversion and pumping in rural areas account for 80 million acre-feet, or 85 percent of the total consumed for all purposes.

This proportion has declined from 88 percent since 1940, due mainly to the growing use in manufacturing and by municipal water systems. Upward trends in the two latter uses are associated directly with population growth and urbanization. Since 1940, they have reduced the overall rate of consumptive use from 34 percent of withdrawals to 28 percent of withdrawals, despite a virtual doubling of total use.

Agricultural Water Uses by Source of Supply

Water withdrawn for livestock and households in areas not served by public water utilities is largely from ground water sources, while 73 percent of the quantity needed for irrigation is withdrawn from streams (table 18).

However, this reflects western rather than eastern conditions, particularly with respect to irrigation. Streamflow serves only about 37 percent of the irrigated acreage in the East.

Table 17.- Trends in withdrawal and consumptive uses of water between 1940 and 1960 in the United States, excluding Alaska and Hawaii

Withdrawal and consumptive use item	1940	1945	1950	1955	1960
Annual withdrawal					
Agricultural uses: 1/					
Withdrawals in million acre-feet	73	83	105	121	135
Average 5-year percent increase	--	13	27	15	12
Withdrawals as percent of all withdrawals	51	47	49	43	40
All withdrawal uses:					
Withdrawals in million acre-feet	143	177	215	280	338
Average 5-year percent increase	--	24	21	30	21
Annual consumption					
Agricultural uses: 2/					
Consumptive use in million acre-feet	43	49	62	71	80
Average 5-year percent increase	--	14	26	15	12
Consumption as percent of withdrawals	59	59	59	59	59
Consumption as percent of all consumption	88	87	88	85	85
All consumptive uses:					
Consumptive use in million acre-feet	49	57	71	83	94
Average 5-year percent increase	--	16	25	16	14
Consumption as percent of withdrawals	34	32	33	30	28

1/ Includes use for livestock, households in rural areas not served with public utilities, and irrigation. Irrigation withdrawals computed from a constant per-acre water requirement of 3.87 acre-feet and irrigated acreage as reported by the Bureau of the Census for the nearest census year. Other withdrawals are as estimated by Walter L. Picton in Water Use in the United States, 1900-1980, U. S. Department of Commerce, Business and Defense Services Administration, March 1960, p. 2.

2/ Constant consumptive-use rates of 60 percent and 40 percent of withdrawals assumed for irrigation and other agricultural uses, respectively. Consumptive-use rates for nonagricultural uses from Picton, p. 5.

Table 18.- Agricultural uses and sources of water in 1959 for the United States, excluding Alaska and Hawaii

Use item	Source of supply	Annual use in millions of acre-feet				Percent of total
		Livestock	Other rural domestic	Irrigation	Total agricultural	
Withdrawal	Surface	0.11	0.36	93.46	93.93	70
	Ground 1/	1.52	4.73	34.56	40.81	30
	Total	2/1.63	2/5.09	3/ 128.02	134.74	100
Consumption 4/	Surface	.04	.15	56.07	56.26	70
	Ground 1/	0.61	1.89	20.74	23.24	30
	Total	0.65	2.04	76.81	79.50	100

1/ Withdrawals and consumptive use apply to both the residual and temporary components of ground water; a substantial portion of temporary ground water eventually will appear as streamflow.

2/ Approximately 93 percent of withdrawals for rural domestic use (including livestock) are from ground water as estimated by Picton in 1960. See p. 5 of reference in footnote 1, table 17.

3/ Approximately 27 percent of withdrawals for irrigation are from ground water. See: Kenneth A. MacKichan, Estimated Use of Water in the United States, 1955, U. S. Dept. of the Interior, Geological Survey Circular 398, Washington, D. C., 1957.

4/ See footnote 2, table 17.

About 70 percent of the water withdrawn and consumptively used for all agricultural purposes is from streams. The remaining 30 percent from ground water is obtained from ground water stocks where withdrawals exceed the annual recharge of aquifers, as they now do in parts of California, Arizona, and Texas.

Trends in Irrigation Water Use and Supply Sources

Population growth, urbanization, and industrialization likely will bring about further declines in agricultural water withdrawals and consumption in proportion to municipal-industrial uses. However, agriculture will remain the principal user of water in the foreseeable future.

Preliminary estimates from the 1959 Census of Agriculture indicate that about 33 million acres are now irrigated on 305,000 farms in the 48 States. Hawaii adds another 141,000 acres and Alaska but 360 acres.

A little over 93 percent of the total irrigated acreage is concentrated in the 17 Western States. Eastern irrigation has declined by 338,000 acres from the 2.6 million acres reported in 1954, due to sizable reductions in rice plantings in the Delta States and modest declines associated with more favorable moisture conditions in 10 other normally humid States. In the Nation, however, irrigation has increased substantially since 1939, with the average annual national rate of increase amounting to 750,000 acres.

Trends over a 20-year period indicate average annual increases of 3 million acre-feet in water withdrawals and of 1.8 million acre-feet in consumptive use.

The proportion of irrigation water withdrawn from ground water sources has increased considerably relative to surface water since 1939 (table 19).

Only 17 percent of the irrigated acreage in the U. S. was served with ground water in 1939. The present use ranges near 44 percent.

Changes in the West, where initial irrigation was largely through streamflow diversion, are even more striking. Trends imply limited additional opportunities for streamflow storage and diversion in historically important irrigated areas, fairly complete use of available streamflow for agricultural or nonagricultural purposes and, for many new irrigation areas, almost complete dependence on ground water.

These and other factors have combined in some basins to create serious water allocation and development problems. Solutions depend on cooperative efforts of individuals, agricultural or industrial groups, and on concerned levels of government. Economic considerations, while important in explaining the nature of present issues, are generally secondary to institutional factors, especially where governmental interests are involved.

Table 19. - Trends in irrigation and associated water use from 1939-59 in the United States, excluding Alaska and Hawaii

Census year	Total irrigated acreage	Irrigation water use		Average 5-year rate of increase 3/	Acreage served by-	
		Acre-feet withdrawn 1/	Acre-feet consumed 2/		Surface water 4/	Ground water 4/
	Millions	Millions	Millions	Percent	Percent	Percent
1939	17.98	69.75	41.85	--	83	17
1944	20.50	79.52	47.71	14	78	22
1949	25.79	100.03	60.02	26	73	27
1954	29.55	114.63	68.78	14	63	37
1959	33.00	128.02	76.81	11	56	44

1/ Estimated from current water requirements. No consistent trends in per acre requirements are observable from published data on water withdrawals and acres irrigated.

2/ Taken as 60 percent of corresponding withdrawals.

3/ Rates of increase apply to irrigated acreage, irrigation water withdrawals, and consumptive use.

4/ Estimated from various reports of the Bureau of the Census, the Bureau of Reclamation, and other sources.

Institutional Aspects of Water Use

Federal, State, and local levels of government all exercise control over water resources. Authority may stem from constitutional provisions, statutory legislation, or judicial decisions.

Federal authority is limited to powers expressly granted or reasonably implied by the Constitution. Within the sphere of delegated power, the Federal authority is paramount. All remaining powers are reserved to the States or to the people.

Federal Activities and Authorities

Activities of the Federal Government are generally concerned with flood control, navigation, irrigation, hydroelectric power, water supply, watershed protection, fish and wildlife preservation, recreation, pollution abatement, sediment and salinity control, drainage, and others, including various combinations in multiple purpose water projects and programs. Regulatory and review functions include licensing non-Federal development of power, deciding controversies and apportioning water between States, and the approving of interstate compacts.

Sources of enabling authority for Federal activities provided by the Constitution include the commerce power, the proprietary power, the treaty-making power, the war power, the general welfare power, the power of equitable apportionment, and the interstate compact approval power.

The commerce and the proprietary powers are perhaps the most important of these authorities. The commerce power provides for Federal jurisdiction over all navigable waters of the United States, including related nonnavigable reaches and tributaries. This power may be used to authorize projects in flood control, navigation, watershed development, hydroelectric power, and multiple-purpose river basin development.

Under the proprietary power, Congress has broad authority to control the use of Federal public lands. It provided the legal foundation for the Reclamation Act of 1902. This source of authority has additional significance for electric power, since energy generated by falling water at a Federal dam becomes exclusive Federal property that may be sold or leased.

Under the treaty-making power, the Federal Government has jurisdiction over international relations concerning the division and development of waters in international streams. Water developments may be modified to serve national defense purposes.

State Water Law

Insofar as consistent with Federal authority, each State may adopt its own system of water law. State laws provide for participation by the State in resource development. They establish conditions for the development, management, and use of water by individuals, firms, and local government bodies. They govern the acquisition and transfer of water rights.

For the most part, non-Federal public and private agencies operate under State laws. The structure and application of such laws, accordingly, are important. Perhaps the most significant type of State water legislation is that dealing with the private water rights of individuals.

The doctrines that govern such rights generally are based on land ownership or prior appropriation. The riparian doctrine accords rights to the use of water to certain land on the basis of the land's contiguity to the supply. The owner of a tract of land on a watercourse has certain rights in the flow of the stream.

In several States the owner may divert any water he needs for domestic use, but for irrigation and other purposes the use must be reasonable with respect to the requirements of others.

The same principle applies to the ownership of land that overlies an underground stream. Some States permit a limited use of the water on nonriparian land provided that the riparian owners are not adversely affected. The riparian doctrine usually applies to both navigable and nonnavigable watercourses, but may be subject to uses for navigation, fishing, or other public purposes.

Under the appropriation doctrine, the earliest right to water from a particular watercourse has priority over all later rights regardless of the location of the land with respect to the stream. This priority means that in times of water shortage earlier rights have precedence over later rights.

Appropriation rights attach to specified quantities of water and often to specific times, places, and methods of diversion. The right is kept in good standing through use. It may be lost through nonuse over a period in most States.

Doctrines applied to percolating ground water include the English rule permitting virtually unlimited use and the American rule of reasonable use, with its modification in the form of the doctrine of correlative rights. Application of the appropriation doctrine to percolating ground water is similar to that for watercourses. Water rights are acquired by those who first withdraw the water and put it to beneficial use.

The riparian doctrine is generally applied to watercourses in 31 Eastern States. Permit requirements are superimposed in some cases upon the basic riparian system.

The riparian doctrine is recognized to varying degrees in the six Western States crossed by the 100th meridian and the three States that border the Pacific. In Hawaii, the riparian doctrine exists along with several other types of rights.

The appropriation doctrine is exclusively followed in eight Western States. It is a part of the law in Alaska and in nine other Western States, and elements of the doctrine exist in some Eastern States.

For percolating water the English rule is still followed in some States, both Eastern and Western. It has been replaced in many by either the American rule of reasonable use or by that of correlative rights.

Thus, the riparian and appropriation doctrines are in effect concurrently in many States. In certain States both may apply to watercourses; in others the appropriation doctrine may apply to watercourses but not to percolating waters.

In the United States the riparian doctrine of water rights is composed primarily of judicial law, although there are a few statutes that affirm the existence of or modify such rights. In the West some constitutional or statutory provisions may sever riparian rights or limit their operation.

The appropriation doctrine, in its operation and extent, is covered by constitutional provisions and statutes, supplemented by hundreds of high court decisions. However, it evolved basically from custom, which in the absence of legislation was recognized by the early courts.

The early statutes essentially codified prevailing customs and regulations. The more elaborate statutes were enacted to cover complications.

State law in appropriation doctrine States usually gives domestic and municipal use the highest preference. Irrigation is frequently second, and commercial and industrial use is third.

The influence of these preferences is limited in many States to the initial granting of appropriations, with an exception sometimes made in periods of extreme drought when water may be rationed according to a special system.

Each of the basic doctrines has certain advantages and limitations. In general, riparian principles are not well suited for comprehensive river basin development. The appropriation principle would appear to have greater possibilities for this purpose.

As water requirements expand, there will be increasing need for a system of water rights that will facilitate resource development and management and will be sufficiently flexible to respond to changing needs.

RESOURCE REQUIREMENTS AND PRODUCTION PROSPECTS IN THE NEXT TWO DECADES

Assumptions and Economic Framework

The relation of national agricultural needs to production potentials over the next two decades and beyond are major factors in land and water policy. Sound planning must be based on the best possible estimates of trends in population growth, economic activity, technology, yields, imports and exports, and the requirements of all the various uses competing for land and water resources.

Population growth is the most important single factor in determining total requirements for land and water resources. Requirements are also affected by other factors such as the composition of diets and the development of synthetic substitutes, which, in special cases, may become significant. Changes in technology affect the production, marketing, and utilization of agricultural products and thus can affect both the requirements for and productivity of land and water resources. Increases in crop yields are largely the result of improved technology.

Exports and imports must also be considered in appraising future requirements. Increased competitive imports may reduce land and water requirements, while increased exports add to requirements.

Nonagricultural uses of land and water will become increasingly important as population increases. Not only will the total requirements increase, but the composition and location of changes in nonagricultural needs will be significant. While the total requirements for these purposes may not seem large, their impact on certain areas and types of land and water resources may be serious.

Public programs must take into account the uncertainties of the future and provide for unpredictable contingencies.

The calculated land and water requirements and production potentials are based on a number of assumptions and economic framework projections. A median population projection representing a level somewhat more than one-third above the United States population in 1960 was selected for 1980. By 1980, disposable personal income per capita is expected to reach a level more than 50 percent above that of 1960; total disposable income is expected to more than double.

Crop yields, water requirements, and other factors affecting estimated output in 1980 are based largely on a projection of trends during the last decade. Since there were no discernible trends in

livestock feeding efficiencies nor in efficiency of irrigation water use, the corresponding projections reflect the levels prevailing during the 1950-60 period. 8/

Population and Income

Prospective population and economic growth in the United States and abroad will directly affect the demand for food and fiber production over the next two decades. For computations in this report the total population for the 50 States is projected at 247 million for 1980, an increase of 36 percent more than the 1960 population. Even greater increases are expected in both total and per-capita disposable income (table 20). Since the income projections are in terms of constant dollars, the increases represent real gains in the output and consumption of goods and services.

Table 20.- Index of population and disposable income, by selected years, and projections for 1980

(1960=100)

Item	1950	1954	1959	1960	1980
Population	84	90	98	100	136
Disposable personal income 1/	73	80	97	100	212
Per capita disposable personal income 1/	86	89	99	100	155

1/ Deflated by Consumer Price Index.

Projected Utilization of Farm Products

Under the assumed economic framework, the domestic use of farm products would be expected to rise by about 40 percent in the next two decades. This estimate is based on the 36-percent population increase and a small increase in per capita use of food.

8/ See the section on Requirements for Cropland for a discussion of the impact of different factors on cropland needs.

In the past decade per capita consumption of food has changed little, even though real per capita incomes have risen by 16 percent. However, with a projected increase of 55 percent in real income per person by 1980, an upgrading of the diet and some increase in per capita use of food can be expected (table 21).

Table 21.- Index of per capita consumption of food and nonfood products, by selected years, and projections for 1980 1/

(1960=100)

Item	1950	1954	1959	1960	1980
Per capita utilization of all farm products	105	101	101	100	103
Food, total	101	101	101	100	105
Livestock	99	101	101	100	109
Crops	105	100	100	100	98
Nonfood	135	105	105	100	85

1/ Consumption net of feed and seed.

Nonfood uses of farm products decreased almost 25 percent per person in the past decade, largely reflecting the increasing use of synthetic fibers, detergents, and other materials. A further decrease is projected for the next two decades, though at a slower rate.

Record exports of farm products in 1960 were about 90 percent above 1950 exports, and reflect, in part, government programs designed to assist exports. Under an expanded Food for Peace Program the goal for exports in 1980 is estimated at a volume 40 to 45 percent over 1960 exports. Total exports estimated for 1980 involve levels of approximately 800 million bushels of wheat, 8 million bales of cotton, 16.5 million tons of feed grains, and substantial quantities of oils and tobacco.

Projected domestic use and export requirements for 1980 would require an increase in farm output of from 40 to 45 percent above 1959. From 1950 to 1960, farm production increased by one-fourth, or nearly 2.3 percent per year compared with the population growth

of 1.7 percent per year. The excess of production above requirements resulted in a substantial buildup of stocks, particularly of grains, in recent years. Because of the current rate of production relative to requirements, as well as the accumulated stocks, the rise in farm output needed to match projected requirements is at a slower rate than in the past decade.

Projected supply and utilization of livestock products imply an increase in required livestock production of some 45 percent more than in 1959. A slightly smaller percentage increase in feed use would be necessary for this level of livestock production.

With crop output in recent years above requirements, and with accumulated stocks of grains in particular, output required to match projected domestic use and exports for 1980 would need to increase nearly 40 percent from the 1959 crop output.

Farm Output Requirements

Farm output is the volume of farm production available for domestic use and export. Three major categories of gross production have been computed--crop production, pasture production, and the product added by livestock. Requirements for farm output are expressed in terms of constant dollars and, accordingly, the changes represent increases in the output of real goods and services. Compared with 1959, projected farm output needed to match projected requirements for 1980 would be up about 40 percent; for crop production, up nearly 40 percent; for pasture, up about 45 percent; and for the net contribution of livestock to total farm output, up about 45 percent (table 22). The estimates reflect no change in the efficiency with which livestock convert feed into livestock products.

Table 22.- Farm output by selected years, and projected requirements for 1980

(1947-49 dollars)

Item	1949	1954	1959	1980 projection	Change 1954 to 1980	Change 1959 to 1980
	Mil. dol.	Mil. dol.	Mil. dol.	Mil. dol.	Pct.	Pct.
Farm output 1/	28,137	30,177	34,583	48,740	62	41
Total crop production	19,874	19,997	23,130	31,800	59	38
Pasture production 2/	1,750	2,035	2,028	2,940	44	45
Product added by livestock	7,876	8,930	9,984	14,350	61	44

1/ Estimates of crop production, pasture production, and product added exceed the value of farm output by the amount of farm-produced power (horses and mules) and the production of hay and pasture seed.

2/ Based on rough approximations of value of feed-equivalent units.

Crop and Pasture Yields

Crop yields for 1980 are based primarily on projections of trends during the last decade. The projected value of crop production per harvested acre for 1980 is 56 percent above 1959 and 89 percent above 1954. The projected value of pasture production in 1980 is 35 percent above 1959 and 43 percent above 1954 (table 23). Attaining the projected yield levels would require continuing emphasis on production research, together with adequate programs to accelerate the adoption of improved practices by farmers.

Table 23.- Crop production per harvested acre, 1954, 1959, and projections for 1980

Item	1954	1959	1980 projection	Change 1959 to 1980
				Pct.
Crop production per acre harvested 1/:				
Value (1947-49 dollars)	58.34	70.65	110.26	56
Index (1954=100)	100	121	189	--
Pasture production per acre 2/:				
Value (1947-49 dollars)	1.87	1.98	2.67	35
Index (1954=100)	100	106	143	--

1/ Projection based on 1950-61 trend.

2/ Value per acre of all pasture and range. Projection derived by combining separate utilization estimates of cropland pasture, open permanent pasture, woodland pasture, and grazing land not in farms. Average is the same as that reported in table 15, Senate Select Committee Print No. 12.

Requirements for Cropland

The projected requirements for crop production in 1980 (table 22) and projected yields (table 23) provide the basis for estimating the required acreage of harvested crops. The projected harvested acreage requirement is estimated at 288 million acres, a decline of 42 million acres from the acreage harvested in 1959 (table 24).

Table 24.- Acreage of harvested crops, cropland harvested, cropland used for crops, and total cropland for 1954, 1959, and projected requirements for 1980

(Million acres)

Type of cropland	1954	1959	1980 projection	Change 1959-1980
Acres of crops harvested	(346)	(330)	(288)	(- 42)
Acres double cropped	(7)	(7)	(6)	(- 1)
Cropland harvested	339	323	282	-41
Crop failure	12	10	11	+ 1
Cultivated summer fallow	29	29	24	- 5
Total cropland used for crops	380	362	317	-45
Soil improvement and idle cropland	19	30	21	- 9
Cropland used for pasture	66	66	69	+ 3
Total cropland	465	458	407	-51

The total cropland required for crops includes allowances for the acreage double cropped, crop failure, and the acreage in cultivated summer fallow. The total cropland needed for crop production is estimated at 317 million acres for 1980, a decline of 45 million from that used in 1959.

Total cropland also includes land in soil-improvement crops and idle cropland, as well as cropland used for pasture. Total cropland required in 1980 was estimated at 407 million acres, a decline in total cropland requirements of 51 million acres in the 20-year period. The increase in cropland used for pasture would supply in part the required expansion in pasture production.

As has been pointed out, calculations of requirements must be based on specific estimates of future population, income, exports, farm technology, and other factors. Departure from these specific projections would, of course, modify the estimates of requirements for cropland. The population projection of 247 million for 1980 was selected because it was the median population projection used in the studies by the Senate Select Committee on National Water Resources. It is essentially the same as the Census Bureau Projection No. III. Another Census Bureau Projection (No. II) results in a population estimate of 262 million for 1980. There are some recent indications that population growth is moving closer to the No. II projection.

The significance of a population 15 million higher than assumed for the calculations in this report would be an increase in cropland requirements of about 20 million acres. On the other hand, export goals represent substantial increases from current levels. A lower level of exports, such as experienced in 1960, would reduce the acreage of cropland required by about 20 million acres.

No increase in livestock feeding efficiency was used in the calculation of cropland requirements. Although recent trends show little change in feeding efficiency, Department studies point to the possibility of an eventual "breakthrough" by farmers in the use of feeding technology. A material improvement in livestock feeding efficiency could reduce cropland needed for the production of feed by as much as 15 million acres. Projected crop yields were based on the trends of the last decade. These projections are 35 percent higher than the yield projections used in the studies for the Senate Select Committee on National Water Resources. Any material departure from the yield projections would significantly affect the acreage of cropland needed to match projected requirements.

A balance of these factors would indicate that prospective cropland resources will continue to materially exceed requirements for meeting future demands for crop and livestock production.

Pasture and Range Requirements

The projected acreage needed for pasture and range were derived from the estimated value of pasture requirements (table 22) and the estimated value of pasture production per acre (table 23), with account taken of the forage value of crop residue. Requirements for pasture and range are shown as increasing more than the estimated increases in yield. A number of possibilities are available for meeting the increased pasture requirements, including intensified pasture improvement practices, increased use of feed concentrates, or shifting varying combinations of additional land to pasture. The estimates (table 25) assume that about one-half of the needed increase would be met by the addition of 3 million acres to the area of cropland used for pasture, and the remainder by shifting land less suited for continuous crop production to pasture. The net increase in land used for pasture would total 22 million acres, 3 million of which would be classified as cropland pasture and 19 million of which would become permanent open pasture.

Table 25.- Land in pasture and range in 1959, and projected requirements for 1980

(Million acres)

Use	1959	1980	Change
Cropland used only for pasture	66	69	+ 3
Open permanent pasture and range	633	652	+19
Woodland and forest pasture and range	245	245	0
Total	944	966	+22

Since pasture yields are higher on cropland pasture than on permanent or other pasture, the entire increase in pasture requirements could be met by increasing the acreage of cropland pasture by 6 million acres. Part of the requirements for pasture could also be met by shifting about 38 million acres of less suitable cropland to permanent pasture.

No material net change is expected to occur in the area of woodland and forest used for grazing.

Timber Requirements

The projected demand for timber for 1980 is 16 billion cubic feet, or about one-third above the current annual consumption. About seven-eighths of this might come from domestic timber, with the remainder from imports.

Needed growth to meet projected demand is estimated at 68 billion board feet, or about 44 percent above present production. Projected growth, based on the continuation of recent trends and no significant changes in the area of forest land, would fall short of needed growth by about 14 percent. Deficits of about 28 percent would occur in growth of eastern softwoods and western species.

The deficit in timber production is expected to become increasingly serious after 1980. Prompt and very substantial expansion and intensification of forestry in the United States will be necessary if timber requirements after that date are met.

The area of commercial forest land available for timber production was estimated at 530 million acres in 1959 (table 26). The amount expected to be available by 1980 is 537 million acres.

Table 26.- Forest land area, 1959, and projected 1980 area

(Million acres)

Class	1959	1980	Change
Commercial	530	537	+ 7
Noncommercial	243	238	- 5
Areas limited primarily to recreation or wildlife use	(27)	(34)	(+ 7)
Total forest area	773	775	+ 2

This net gain results from an expected shift of 19 million acres of cropland and 8 million acres of pasture and range to commercial forest, compared with shifts from commercial forest to other uses of about 20 million acres. However, in view of the timber demand situation and the fact that forest land will continued to be sought for other uses, no surplus of commercial forest land is in prospect. A net of 5 million acres of noncommercial forest land is expected to shift to other strictly nonforest uses. Thus, the overall gain in forest land area is only about 2 million acres. It is expected that the use of 34 million acres of forest land will be limited primarily to recreation or wildlife purposes in 1980, or 7 million acres more than in 1959.

Nonagricultural Land Requirements

Nonagricultural uses of land may be considered in terms of two categories: special-purpose uses and miscellaneous other areas. The special-purpose uses may be divided into three subcategories: urban and built-up areas, areas limited primarily to recreation or wildlife use, and areas used for public installations and facilities. These last-named uses include national defense, water control and supply structures, and public industrial and experimental areas.

The total acreage needed to meet land requirements for special-purpose uses is expected to reach 195 million acres by 1980, an increase of 48 million acres over 1959 (table 27). A decline of 11 million would be expected in the acreage in miscellaneous other areas.

Table 27.- Nonagricultural land uses, 1959, and projected requirements for 1980

(Million acres)

Land use	1959	1980	Change
Special-purpose uses	147	195	+ 48
Urban and built-up areas	54	74	+ 20
Recreation and wildlife areas	62	85	+ 23
Forest land	(27)	(34)	(+ 7)
Nonforest	(35)	(51)	(+ 16)
Public installations and facilities	31	36	+ 5
Miscellaneous other areas	277	266	- 11
Total nonagricultural	424	461	+ 37

Urban and Built-up Areas

Acreage required by urban expansion and the needs for such other uses as highways and airports are expected to absorb an additional area of 20 million acres by 1980. This would assume a continuation of the rate of absorption in recent years of about 1 million acres a year.

Recreation and Wildlife Areas

Recreation and wildlife areas include National, State, and local parks; fish and wildlife areas; and related areas designated as primarily for recreational use. The area designated as primarily for recreational or wildlife use is expected to comprise 85 million acres by 1980, including 34 million acres of forest land (table 27).

Public Installations and Facilities

The areas devoted to national defense, water control reservoirs, public industrial lands, sites for experimental work, and other related uses totaled 31 million acres in 1959. The area likely to be in this use is estimated at 36 million acres in 1980.

Miscellaneous Other Areas

This category consists of desert, bare rock, swamp, and other similar types of land. Although their economic use is often limited, such areas do provide space which may be used to meet a part of the requirements for urban expansion and other nonagricultural uses.

This acreage totaled 277 million acres in 1959. About 62 million acres of this total was in the 48 contiguous States and 215 million acres was in Alaska and Hawaii. The area in this class of land is expected to decrease to 266 million acres by 1980 because 11 million acres are expected to be shifted to special-purpose uses.

Major Land-Use Patterns and Shifts, 1959-1980

The largest adjustment in land uses would be required in cropland, where a net reduction of 51 million acres is needed to balance supplies and requirements. The needs for grassland pasture and for urban and other special-purpose uses will require considerably more area by 1980 (table 28).

Table 28.- Shifts in major land uses, 1959-1980

(Million acres)

Land use	1959	Reductions	Additions	Net change	1980 projections
Cropland	458	68	17	- 51	407
Grassland pasture and range	633	30	49	+ 19	652
Forest land 1/	746	32	27	- 5	741
Farmsteads and farm roads	10	0	0	0	10
Special-purpose uses	147	0	48	+ 48	195
Miscellaneous other land	277	11	0	- 11	266
Total	2,271	141	141	0	2,271

1/ Commercial and noncommercial forest land, exclusive of 27 million acres of forest land limited primarily to recreation or wildlife use in 1959 and 34 million acres in 1980. Combined forest land acreage was 773 million acres in 1959 and is projected at 775 million acres in 1980, or a net overall gain of 2 million acres.

It is estimated that the 68-million acre shift from cropland would be partly offset by a shift of 17 million acres from other uses to cropland. The reduction in cropland would permit the withdrawal of about 25 million acres of land considered unsuited for regular crop production. The remainder would consist of land considered suitable for crop production in case of need for that purpose.

About one-sixth of the total reduction in cropland would be absorbed by urban expansion and other special uses. Somewhat more than one-half would be shifted to pasture and range use, while about one-fourth would be converted to forest (table 29).

Shifts to and from forest land are almost in balance, with the expected acreage in noncommercial forests in 1980 being down about 12 million acres, and that in commercial forests being up 7 million acres.

The reduction in miscellaneous other land uses would be taken up by urban expansion and other special-purpose uses.

Increases of almost 40 percent would be expected in urban and recreational use areas. An increase of over 15 percent in areas devoted to public installations is expected. Increases in urban and other special uses would be drawn initially from all major use categories. Since most of these losses would be replaced by further diversions of cropland, the ultimate incidence of absorption by increased nonagricultural uses would be on cropland.

The net shift from agricultural to nonagricultural uses would total 37 million acres.

Table 29.- Composition of shifts in major land uses, 1959-80

(Million acres)

Land use shift from-	Total reduction	Shift to-					
		Cropland	Urban and built-up areas	Areas limited primarily to recreation or wildlife use 1/	Public installations and facilities	Pasture and range	Forest
Cropland	68	-	5	5	1	38	19
Pasture and grazing	30	10	5	6	1	-	8
Forest	32	7	5	2/ 7	2	11	-
Commercial	(20)	(7)	(3)	(4)	(1)	(5)	(-)
Noncommercial	(12)	(-)	(2)	(3)	(1)	(6)	(-)
Miscellaneous other	11	-	5	5	1	-	-
Total addition	141	17	20	23	5	49	27

1/ Including open space.

2/ Indicates a priority of forest use and not a reduction in forest land area such as results from a shift to cropland or other nonforest uses.

Projected Water Uses

Water use trends for purposes other than irrigation were projected directly (table 30). The projections indicate the 1980 pattern of water use if these trends continue.

Table 30.- Supplies and uses of water in 1960 and 1980 in the United States, excluding Alaska and Hawaii

Supply and use items	Supply or use in 1960		Supply or use in 1980		
	Millions of acre-feet	Percent of total	Millions of acre-feet	Percent increase 1960-80	Percent of total
Annual renewable supply 1/	1,326	--	1,326	--	--
Annual withdrawals:					
All withdrawal uses 2/	338	100	835	147	100
Agricultural withdrawals 2/	135	40	174	28	21
Irrigation withdrawals	128	38	164	28	20
Irrigated acreage in millions	33.0	--	42.4	28	--
Annual consumption:					
All consumptive uses 2/	94	100	138	46	100
Agricultural consumption 2/	80	85	102	28	73
Irrigation consumption 3/	77	82	98	28	71

1/ Taken as annual streamflow supply under the assumption of no change in on-site land use, and no additional structures.

2/ Based on exponential extrapolation of given water-use trends for uses other than irrigation, with totals adjusted for irrigation use based on extrapolation of irrigated acreage rather than historical water-use data.

3/ Based on a consumptive use rate of 60 percent of withdrawal requirements.

On the basis of past trends, it is estimated that total water withdrawals in the 48 States in 1980 would amount to 63 percent of renewable surface and ground water supplies, as contrasted to 25 percent in 1960. However, 83 percent of the water withdrawn in 1980 would be available for reuse, compared with 72 percent at present. The consumptive use of water is estimated to increase 46 percent, or to 138 million acre-feet compared with the 94 million acre-feet presently consumed.

Agriculture would continue to be the predominant consumptive user of water in 1980. Irrigation and other agricultural uses of water would be expected to account for 73 percent of the total consumptive use in the 48 States in 1980, compared with 85 percent in 1960. Consumptive use attributable to irrigation alone would fall from the current 82 percent to 71 percent by 1980, despite a projected increase of 9.4 million acres in irrigated land.

In evaluating the adequacy of the Nation's water supply for meeting anticipated uses in 1980, it should be recognized that present uses already either approach or exceed the limit of available supplies in many of the major western river basins, and that municipal and industrial demands have created supply and treatment problems in many localities in the East. Moreover, a general conclusion applicable to all areas is that the economic management of water in agriculture is critical for balanced growth of all water-using industries and the entire economy, because of the present high rate of consumptive use in agriculture compared to other industries. Modest gains in the efficiency of agricultural water use will result in substantial increases of supplies available for other uses. To illustrate such possibilities, a recent report of the Senate Select Committee on National Water Resources indicates that by 1980 improved irrigation practices on farms, together with reduction of evapotranspiration and seepage losses from irrigation storage and delivery facilities, could result in a 20-percent reduction in overall water requirements for irrigation--from 3.87 to 3.10 acre-feet per acre irrigated.

If such gains in efficiency should materialize, water consumption for irrigation in 1980 would total 78 rather than the 98 million acre-feet shown in table 30, representing only a 1-percent increase over the current consumptive use in spite of the projected 28-percent increase in irrigation acreage. Moreover, the 20 million acre-feet thus saved in irrigation would be multiplied 4.25 times, thus releasing 85 million acre-feet annually for additional industrial use. This is due to the different rates of consumptive use (and therefore possibilities for reuse) between irrigation and manufacturing.

Aside from such technologic advances as sea water conversion and possible weather modification, other opportunities exist for increasing renewable water supplies. Snow accumulation, sublimation, and melting rates can be controlled to some extent. More important, are possibilities for increasing downstream water yields through the management of vegetation in upstream tributaries. Experimental evidence indicates, for example, that significant absolute increases in water yield from forested watersheds in high-elevation and high-rainfall areas can be obtained through improved vegetation management. Opportunities for such increases appear most favorable on about 15 percent of the area of the Western States.

Multiple Uses

The objective of harmonized and integrated multiple use is increasingly becoming the guiding principle of management for much of our public and private land and water resources. Such management is designed to provide for a rational accommodation of the various uses, including consideration of all legitimate uses and efforts to reconcile conflicts so that no one use is permitted to destroy or seriously impair other desirable uses. Management under this policy involves exceedingly difficult problems, partly physical, partly economic, and partly political.

Public Law 86-517 specifically directs that the National Forest System be managed for the multiple use and sustained yield of its surface resources, including such purposes as outdoor recreation, range, timber, watershed, and fish and wildlife. A similar legislative proposal applicable to land under the administration of the Bureau of Land Management is now under consideration by the Congress.

Multiple use is not wholly contingent on legislative directives. Much of our public and private land has long been used for more than one purpose; multiple-purpose development of water resources is generally accepted, and economic principles have been developed to guide the formulation of such developments. Possibilities for further encouraging the multiple use of private land are particularly significant. General improvement of cropland and pasture management is likely to have a salutory effect on watershed runoff and water quality. Much can be done on private lands to improve wildlife habitat, particularly for small game and upland game birds. The whole problem of encouraging more diversified use of private land by the owners, and of making certain types of private land available for public use under terms attractive to owners, is one of the frontiers of land policy. Although a start has been made toward opening private lands to public hunting and fishing through State purchase of easements, the next 20 years should bring many other new developments in this field.

Outdoor Recreation

Outdoor recreation is one of the increasingly significant types of multiple uses. Projections of total demand for outdoor recreation are still in the embryonic stage of development. The chief difficulties are lack of reliable information on which projections could be based, and uncertainty about the factors that influence the growth of outdoor recreation.

Using some very simple techniques, the Forest Service has estimated that use of the National Forests may increase from the 1960 level of 92.6 million visits to about 300 million by 1980 and to about 635 million by the year 2000. A similar estimate for the National Park System, developed by the National Park Service, contemplates an increase from the 1960 level of 79.2 million visits to about 400 million by the year 2000. Both of these estimates imply a considerable slacking-off in the rates of increase experienced during the past fifteen years. Comparable projections are not available for recreation use of the State park systems, which accommodated 255 million visits in 1959. Nor are such projections available for the other publicly owned land and water areas used for outdoor recreation.

Looking ahead to 1980 and considering the increases projected for the National Forests and the National Parks, it seems reasonable to expect that outdoor recreation in terms of visits to public recreation areas may increase to 3 or 4 times what it was in 1960.

The total acreage of public land and water areas (outside urban communities) designated by administering agencies as being available for public recreation use in 1960 is approximately 240 million acres. Of this, about 60 million acres might be considered as primarily for recreational use.

Data are not available on present or prospective outdoor recreational use of private lands or of the acreage of such land that is now or may, by 1980, be held primarily for recreation. However, it is believed that the use of private land for outdoor recreation greatly exceeds such use of public lands and that this situation is likely to continue.

Fish and Wildlife

There have been two fairly recent nationwide surveys of hunting and sport fishing by the U.S. Fish and Wildlife Service--one in 1955 and another in 1960. Those surveys show that more than one-third of all households in the United States have one or more members who engage in hunting or sport fishing.

About 25 million persons participated in these sports in 1955. By 1960, that number had increased to about 30 million. This represents an average annual increase of 1 million, or a rate of approximately 4 percent a year. If that rate of increase continues during the next two decades, there will be 50 to 60 million hunters and fishermen by 1980, or twice the number we now have.

Hunting activity in 1960 by type of hunting was distributed as follows: total number of persons who hunted, 14.6 million; big game, 6.3 million; small game, 12.1 million; and waterfowl, 2.0 million. As indicated by the excess of the number of persons engaging in types of hunting over the total number of hunters, a large number do not limit their sport to one type of game. The great popularity of small game hunting, which includes hunting of upland game birds, is of special interest. This probably occurs principally on private land. Distribution of the number of fresh-water fishermen in 1960, by types of water fished most often, was as follows: total number of persons who fished, 21.7 million; on natural lakes and streams, 7.5 million; on rivers and natural ponds, 6.9 million; on man-made reservoirs, 4.8 million; and on man-made ponds, 2.5 million. About two-thirds of the fresh-water fishing occurred on natural waters. This, of course, implies problems of land access to such waters and rights to travel along stream banks.

The public land and water area dedicated to this special use in 1960 amounted to 29.2 million acres. Of this total, 7.8 million acres were in Alaska. Within the 48 contiguous States there were 21.4 million acres administered by fish and wildlife agencies. By level of government, this total was distributed as follows: Federal, 8.8 million acres; State, 12.5 million acres; and county and local, 0.1 million acres.

The impressive extent to which States have been acquiring land for wildlife conservation purposes is a reflection of popular concern and of the substantial revenues becoming available to States through certain Federal taxes on sporting arms and ammunition and on certain kinds of fishing tackle. There is every prospect that this activity will continue, and that the land acreage dedicated especially to wildlife will expand substantially during the next 20 years. A large part of the increased acreage will probably be wetlands for migratory waterfowl. Establishment of a very large artic game refuge in Alaska is presently being considered.

Policy Implications

The policy and program implications of this land-use analysis are given in Part I of this report.

PART III - APPENDIX

REVIEW OF EXISTING PROGRAMS AFFECTING LAND AND WATER RESOURCES

This Part contains statements on existing programs in the U.S. Department of Agriculture as they relate to the use, conservation, development, productivity, ownership, and management of land and water resources. It should be recognized that most programs have several purposes and it is difficult to review their impacts in terms of specific land and water resource objectives as outlined in this report.

GENERAL SUMMARY OF EXISTING PROGRAMS

The rapid rise in agricultural production since the end of the 1930's has resulted from mechanization, genetic improvement of crops and livestock, increased use of feeds and fertilizers, soil and water management practices, and land and water development. The past 20 years has been a period of release of 37 million cropland acres from production of horse feed to production of human food and of feed for food animals. We have substituted a beef cow for each horse that has disappeared, to consume pasture, range and harvested forage formerly needed for horses. This change cannot happen again.

Hybrid corn and hybrid grain sorghum have come into common use. This, too, is a one-shot advance. Pesticide and fertilizer chemicals have increased rapidly in use with resultant yield increases. We have no reason to suppose that chemical use and response will not continue to increase at current or even accelerated rates generally, though there may be exceptions.

Research, education, technical assistance, financial aid and credit programs conducted by the U.S. Department of Agriculture in cooperation with States, farmers, and their local organizations have made remarkable achievements during these past 20 years and can and should be even more effective during the next 20.

The use and development of our forests progressed rapidly in the past few decades. For example, in the last 10 years more than 11 million acres have been planted to trees; recreational visits to public forest land have more than doubled; and pulpwood production has almost doubled. Cooperative State and Federal efforts have resulted in a sharp downward trend in forest area burned, the production of billions of trees for planting stock, and much technical forestry assistance to farmers and other owners of small forest tracts. Research has made significant contributions in such diverse fields as nursery operation, wood utilization, fire control, inventory, and silviculture.

Congress has determined that the 186 million acres in the National Forests and National Grasslands shall be managed for multiple use and sustained yield of the several products and services obtained therefrom. Widespread acceptance of the need for coordinated use of forests for watershed protection, timber production, recreation, wildlife and livestock forage is apparent and this concept is being extended to most State, private and other Federal forest lands.

Rising pressures upon forest land stemming from increasing demands for all forest products and values clearly indicate the need for much-expanded action programs in National Forest development, State and private forestry, and forest research. Losses from fire, insects, and diseases are still well above acceptable levels, the future of our softwood sawtimber supply is uncertain, and hardwood quality is declining. From a timber supply standpoint, the most significant problem is the 53 percent of the Nation's commercial forest land located on millions of farms or other small private ownerships and that are far below productive capacity.

There are 3,382,500 farm woodlots in the United States and this comprises three-fourths of all private holdings of commercial forest lands. Much of the timber growth in farm woodlots is, however, in species with little commercial value. Although Farmers Home Administration can make loans for improving farm forests on a 40-year basis at 5 percent interest, consideration needs to be given to additional ways of stimulating forestry planting on privately owned farm woodlots. Some possibilities are: (1) Long-term, low-interest-rate loans with deferments of principal and interest while timber is growing; (2) tax concessions; or (3) adjustment payments by the Federal Government for changing the use of such land.

Sound land use along with the protection and improvement of soil and water resources has become the symbols of conservation farming in many parts of the country. Conservation operations in 2,900 soil conservation districts covering 96 percent of the farms in the Nation; application for assistance from local organizations in almost 1,600 small watersheds; installation of watershed works of improvement in 359 small watershed projects and in 11 authorized watersheds; and the Great Plains Conservation Program in 361 designated counties attest to the effectiveness of furnishing technical and financial aid to local organizations and to cooperating farmers and ranchers through local action programs. Conservation practices have been, and are being, applied under several programs administered by the Soil Conservation Service by more than 1,887,000 district cooperators, who operate about 600 million acres of land. Their cropland, grazing lands, and farm woodlands are being stabilized and improved through scientific conservation methods.

These conservation programs reduce soil losses, improve the use of available water, and prevent or reduce sedimentation of reservoirs, lakes, and streams. They also reduce the loss of crops stabilize yields, prevent damages from sediment on nearby areas, and release cleaner water into flowing streams. More important, however, is the immediate and long-term protection of land, water, and plant resources of the United States.

The requirements of the next two decades make it necessary to move ahead more rapidly with the needed soil and water conservation work. The programs and work plans of soil conservation districts, prepared and conducted with other local interests, have become the instruments through which Federal, State, and local efforts are effectively coordinated to serve the needs of rural communities. The experience and broad coverage of such districts, formed and operated under State laws, afford an effective way of continuing the same types of program assistance in soil and water conservation throughout the country.

Recognition of increasing needs for multiple use of our forest resources for wildlife, recreation, watershed use, as well as for timber production, makes the task of forestry research and forest management formidable indeed. We can meet future needs, but accelerated research and action programs are essential in order to do so.

Soil and water conservation practices, together with the land-forming and water-retention structures associated with them, are saving our land--indeed, in many areas have reclaimed it--from the wind erosion in the Great Plains as in the 1930's, from the inroads of water erosion in the Southeast and in other areas, and have helped to stem the decline in fertility and tilth in our croplands generally. The Soil Conservation Districts have grown into a mighty force truly dedicated to the protection of our soil and water for sustained beneficial use.

The Federal-State cooperative extension service has helped farmers everywhere to learn, especially to learn by doing. Farmers have learned to use machines effectively; to use new crops and new agronomic and livestock production techniques. These practices will continue to change with bewildering rapidity, especially in the marketing and quality control areas. Extension services are essential to the ability of farmers to meet future changes requiring products of specified kinds and qualities in continuous supply and to retain for themselves their cherished prerogative of decision-making, and to obtain a fair return for the management, labor, and capital resources they risk in farming.

Rural Electrification Administration, Farmers Home Administration and agricultural credit services generally will continue to be essential aids to the achievement of farm efficiency, a high material level of family living, and to the social, cultural and economic growth of rural communities. We have lights; we need much more utilization of electrical power for farmstead and household, an assurance of adequate and economical sources of rural power supply, more and better communications service, better supplies of household and stock water, better waste disposal facilities, more and adequate rural housing.

The FHA has been making loans during the past 23 years for financing rural water systems. The demand for such assistance has increased tremendously in the past five years, and this was recognized by the Congress by including greatly broadened authorities in the Agricultural Act of 1961. A recent nationwide survey indicates that FHA can expect to receive loan applications for more than $700 million in the next 20 years to install or improve domestic water facilities for at least 850,000 rural families. To meet this demand, the maximum limit on loans to associations should be increased.

Acreage allotments and marketing quotas have been in effect for wheat, cotton, rice and peanuts each year since 1954, and for the major kinds of tobacco since 1938. As a result, the acreage of cropland devoted to these crops has declined nearly 29 percent since 1952-53. The major shift in cropland use has occurred in wheat and cotton. Much of this acreage taken out of wheat and cotton, and the other crops under marketing quotas, was shifted to production of other crops.

The authority to take new land into the Conservation Reserve of the soil bank expired with the calendar year 1960. At the end of the signup of contracts for new areas in 1960, there were approximately 28.7 million acres of cropland retired in the Conservation Reserve.

Nearly 1.2 million corn and grain sorghum producers signed up in 1961 to participate in the feed grain and wheat programs indicating that they intended to retire about 26.7 million acres to a conservation use. The July 1961 Crop Report indicates that the acreage of corn and grain sorghums has been reduced about 20 million acres from the 1959-60 average.

The impact of acreage allotment programs on existing cropland has been to shift some land from the allotment crop to another crop or use. Cotton farms shifted land out of cotton into soybeans, feed grains or pasture crops. Wheat farms in the Southern Plains shifted land out of wheat into grain sorghum, forage sorghum, other crops, or fallow. Wheat farms in the Northern Plains and the Pacific Northwest shifted land out of wheat into barley, oats, minor crops, or fallow. The Western wheat regions made no appreciable shift from wheat into forages for livestock.

To date, over 3 million acres of trees have been planted and over $2\frac{1}{4}$ million acres of timber have been improved on farmland under the Agricultural Conservation Program. It is estimated that well over 30 million acres of land formerly in intensive crop use have been shifted to permanent pasture and similar sod crop uses with conservation program cost-sharing assistance. In addition,

water control practices, such as terracing, leveling, or draining that are essential to continued efficient agricultural use of farmland have been applied on at least 73 million acres through the ACP.

Research has produced, and can, if adequately supported, continue to produce the tools and methods which will enable farmers to accomplish rapid economic growth and adjustment.

Few realize the adjustments already accomplished, now underway, or imminent in agriculture. For example, soybeans, now occupying about 27 million acres of cropland, was a minor crop in the 1930's. Research has developed varieties varying in length-of-day and days-to-maturity requirements so that soybeans now thrive from the Delta to Dakota. Lines resistant to soybean cyst nematode will soon be available. Hopefully, genetic stocks adapted to the shorter photoperiods of the Gulf Coast and Florida will still further extend the range of this crop.

While progress with soybean production has been remarkable, adaptation to animal feeding, especially to poultry and swine feeding through controlled heat processing, amino acid balancing, and vitamin supplementation has made soybean oil meal our mainstay protein concentrate and formed thus far a profitable market for our rapidly increasing supply. Still to solve is the puzzle of meager yield response of soybeans to fertilizer. The only presently prospective means of increasing soybean production substantially is through increased acreage.

Research is producing needed flexibility in feeding beef and dairy cattle. With greatly improved efficiency of production and handling of feed concentrates, the proportion of our beef and milk from concentrates, compared to that from forage, is steadily increasing. It seems certain that research will make it economically feasible to get most of future needed increase in beef and milk from concentrates, sparing some of our grassland for potential wildlife, watershed, and recreational use.

Fruits and vegetables pose special problems since these crops are best grown on specially suited lands. We have little land not now in citrus which is as well-adapted to citrus as present citrus lands. Especially in California, citrus land is being urbanized; citrus in the lower valley of the Rio Grande has suffered catastrophic losses from hard freezes and probably will do so again unless we can produce either cold-hardy genetic stocks or management methods rendering present stocks cold-hardy, or both. Florida citrus has also suffered from freezes, and California citrus may have to move into high frost-risk areas. Old peach and pear areas are presently suffering from root disease and "pear decline."

Vegetable land is even more strictly limited than fruit land. Soil-borne diseases still make monoculture hazardous.

Mechanical harvesting methods may sharply reduce realized fruit, vegetable, and tobacco yields per acre, since economies of once-over mechanical harvesting may outweigh added yield from successive hand harvests.

Improvements in technology have increased the size of farm which a farmer and his family can handle. Consequently, the trend has been toward fewer but larger commercial family farms. Primary control of land and water resources is vested in far fewer hands today than 20 years ago.

Economic adjustment studies of representative types of farming situations provide data for analysis of the aggregate effects, in terms of regions and the Nation as a whole, of adjustments which appear profitable to individual farmers. Increasing emphasis is being given to this kind of analysis, which provides an analytical basis for formulation of policies and programs, for adjustment of farm production and resource use. Farm programs, in turn, will continue to have marked effects on the use of farmland.

FHA has assisted 2 million farm families with $5.5 billion of intermediate and long-term farm credit coupled with farm management planning and supervision. This assistance has enabled many of the borrowers to establish recommended soil and water practices accompanied by adjustments in their farming programs essential for improved family living and conservation of their soil and water resources. This program will be continued and expanded under the broadened authorizations in the Agricultural Act of 1961. The long-term loans will promote fee-simple ownership by helping many young farmers to become established in farming and by helping established farmers to enlarge or improve the land and water resources they have. Intermediate and short-term credit will continue to help farmers operate efficiently and make shifts in farm programs that will better utilize land and water resources.

It is estimated that the family farm redevelopment phase of rural areas development will:

1. Over the next 15 years, assist 400,000 inadequate farm units to reorganize and develop into adequate family farms, and

2. Provide needed services for 650,000 rehabilitation-in-place and retirement units of operators who, because of age, physical or other handicaps, are unable to shift to more promising farm or nonfarm occupations.

Adequate water resources development is necessary for adjustments in the handling of land for agricultural purposes and in the supplying of adequate water to nonfarm populations. Overall water resources planning and development must be fitted into proposed changes in land use.

Water resources development must be closely related to recreational development. Adequate flood control and conservation of water will be of importance to the successful utilization of the land. Water resources development and utilization must also be related to the need for water by new industries being established in the rural towns. Hundreds of rural communities do not have adequate water supplies or adequate sepage disposal. Both water facilities and sewage disposal must be developed as new employment opportunities are developed. Almost one-fourth of the people of the Nation face a water shortage or have poor water, or both. By 1980, it is estimated that we will need twice as much water as is currently used.

Agriculture uses about 40 percent of all water withdrawals. Growth in nonagricultural uses--municipal, industrial, pollution control, recreation, wildlife, and other--will reduce the share available for agriculture in the next 20 years. The efficiency of use of water diverted for agriculture can be substantially improved. The programs of the Department should use extension, technical assistance, credit, and financial aid to encourage water users to achieve more efficient water use. A vigorous program of research in all phases of water use, conservation, and development will be necessary to assure sufficient water supplies for efficient agricultural uses and to meet the increasing demands for other purposes.

THE SOIL CONSERVATION SERVICE PROGRAM

The Soil Conservation Service is responsible for developing and carrying out a national program of conservation for land and water resources.

The program includes activities authorized by several acts of Congress. The principal ones are shown in the footnote below.

The central objective of the SCS is an integrated system of land use and conservation treatment in harmony with the capability and needs of the land. This is accomplished through unified planning that combines all the technologies, considers all the resources, and recognizes all the human interests that apply to each area of land.

Integrated Technical Planning

To meet this objective, the SCS brings together scientists and technologists from every discipline that can help to diagnose land problems and prescribe successful treatment. The technical staff includes soil scientists, engineers, geologists, hydrologists, range and woodland conservationists, biologists, economists, and, as circumstances require, other specialists.

These diverse technologies are projected and brought into focus on the land through a professional worker developed by the SCS--the soil conservationist. He is a conservation technician skilled in combining the methods and information of the physical, biological, and social sciences and applying them to practical problems of landowners and users.

A second way in which the SCS integrates all aspects of land use and treatment is by assisting farmers and local groups to plan for each farm, ranch, watershed, or other land area as a whole--both

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1/ Principal legislative authorizations of the Soil Conservation S Service: The Soil Conservation Act (Public No. 46, 74th Cong., 1935); the Omnibus Flood Control Act (Public Law 738, 74th Cong., 1936); the Flood Control Act (Public Law 534, 78th Cong., 1944); the Watershed Protection and Flood Prevention Act (Public Law 566, 83rd Cong., 1954, as amended by P.L. 1018, 84th Cong., 1956, P.L. 85-624, 85th Cong., 1958, P.L. 85-865, 85th Cong., 1958, P.L. 86-468, 86th Cong., 1960, and P.L. 87-170, 87th Cong., 1961); and the Great Plains Conservation Program (Public Law 1021, 84th Cong., 1956, as amended by P.L. 86-793, 86th Cong., 1960).

as an economic unit and as a combination of land resources. Equally fundamental is the concept that the several land resources--soil, water, plants, and animals--cannot be effectively used or managed separately. They are completely interdependent. Hence, the land must be dealt with as a whole, acre by acre and farm by farm.

The application of integrated skills to the land as a whole requires a realistic appraisal of the combination of resources at any particular location. For this reason, conservation planning begins with a scientific soil survey, supplemented by such inventories of water, plants, or animals as may be needed.

The Soil Conservation Service recognizes people as a dominant factor in each local resource situation and as the reason for conservation itself. The resources of soil, water, plants, and wildlife are significant only as they provide for the needs of people. On the individual farm or ranch, the owner or operator makes the decisions. The SCS technician interprets the soil survey and resource inventory in terms of feasible alternative physical and economic systems of land use and treatment. The needs and desires of the farmer or rancher get full consideration in the resulting plan, for it is, in fact, his own plan.

Local people initiate and direct their own programs through their soil conservation districts. In each case, the Service is careful that measures recommended by its technicians are consistent with the local district program.

The effective integration of all aspects of land use and conservation planning--of technologies, of land resources, and of the interests of people as they apply to each unit of land--is the unique feature of the work of the SCS.

Assistance to Soil Conservation Districts

Public Law 46 established soil and water conservation as a national policy and created the Soil Conservation Service in April 1935. Farmer participation and local control were recognized at once as essential ingredients of an on-the-farm action program. This led to the soil conservation district idea and farmers began to organize such districts under State laws in 1937.

By July 1, 1961, there were 2,900 districts in the United States. They included 90 percent of the Nation's agricultural land and 96 percent of the farms and ranches. Twenty-three States were completely covered by districts. More than 14,000 local farmers and ranchers were members of the boards that govern these districts. They serve without pay from any source, much like local school board members.

The State enabling laws provide for State Soil Conservation Committees (Boards or Commissions), the membership of which are either named in the acts or are appointed by the Governor. As an agency of State government they guide the organization of districts and facilitate their functioning. They also serve to coordinate soil and water conservation functions of the State governments. In most States, these agencies were designated by the Governors to give State-level leadership to watershed program activities.

The soil conservation district has become a permanent part of the American agricultural scene. It is the central source of help and information about soil and water conservation in nearly every community of the Nation. The SCS has the major job of providing technical assistance to farmers and ranchers in planning and carrying out soil and water conservation in line with the conservation program adopted by the district board.

Farm and Ranch Conservation Plans

Individual farm and ranch soil and water conservation plans are the backbone of assistance to soil conservation districts by the SCS. Nearly all farms or ranches need planned conservation programs, based on currently sound technology, to guide their conservation progress effectively.

SCS recognizes that soil and water conservation must be accomplished through human effort, and that it gets done only when the farmer or rancher has (1) the knowledge, (2) the desire, and (3) the means to do it.

SCS policy has always been to help soil conservation district cooperators plan practical conservation progress wherein land is used within its capability and treated according to its need for the planned use.

The basic jobs of SCS as the Department's technical agency in soil and water conservation are (1) to show cooperators why planned conservation is needed on their land, (2) to show them how to do the more difficult jobs, and (3) to inspire them to action.

By June 30, 1961, SCS had assisted 1,358,290 farmers and ranchers to prepare basic conservation plans. An additional 530,000 farmers and ranchers were being assisted by SCS as they worked to the completion of their plans.

Soil Survey Work

Soil surveys provide the base for nearly every other phase of the SCS program as well as for programs of many other agencies and organizations.

SCS has leadership responsibility for the Federal part of the National Cooperative Soil Survey. The work is carried out in cooperation with the State agricultural experiment stations, the Forest Service, and many other State and Federal agencies.

The basic purposes of the soil survey are: (1) To determine the important characteristics of soils; (2) to classify the soils and name them according to a nationwide system; (3) to interpret the soils according to their capabilities for use under alternative management systems for crops, grasses, and trees, and according to the properties significant to engineering; (4) to show the distribution of soils on maps of high accuracy at scales appropriate to the landscape; and (5) to publish the results in soil survey reports including maps, the basic soil descriptions, and the basic interpretations. In addition, SCS cooperates with other agencies who prepare special maps and reports designed for immediate use by farmers and other users.

Farm Woodland Work

The SCS provides, to private landholders, technical assistance in conservation on woodlands as a necessary part of a conservation plan for a land unit. For many thousands of owners of small woodlands, this is the only encouragement or assistance they have ever had to improve and make use of their woodlands.

SCS Work Unit Conservationists are trained to give assistance in the selection of land suited for tree-planting and to give technical assistance in planning woodland practices such as tree-planting, stand improvement, windbreaks, shelterbelts, gully stabilization, streambank control plantings, and similar conservation practices involving trees and shrubs.

Because a high proportion of total forest holdings are in private ownership as parts of farms and interspersed with farms, soil conservation districts have generally included woodland conservation and forestry services as an integral part of their program. In 1960, nearly half of all trees planted on private lands were on farms and ranches cooperating with soil conservation districts. Tree-planting has nearly tripled in soil conservation districts since 1956. In 1960, nearly a million acres of trees were planted in districts.

Range Conservation Work

Since a third of the Nation's farm and ranchland is used for the production of native forage and produces a large part of our meat and wool, conservation work on non-Federal rangelands is one of the major activities of the SCS.

A sound conservation program on rangelands starts with a knowledge of the soils, just as it does on lands used for other purposes. This important fact was not adequately recognized for many years. SCS developed technology to recognize and map soil differences reflected in native vegetation as a sound basis for range conservation and management. This information gives landowners the key to the potential productivity of their range. An appraisal of the condition of the range, area by area, furnishes clues to action needed for its improvement.

Wildlife Conservation Work

The SCS gives consideration to wildlife values in all its activities. It recommends and helps farmers and ranchers in soil conservation districts plan positive steps to increase wildlife as a primary product of the land where appropriate and as a part of the multiple use of soil and water resources. In all activities it seeks to avoid unnecessary damage to wildlife and to favor the increase of beneficial species as a corollary result of land use and soil and water conservation practices.

Experience clearly demonstrates that wildlife, including waterfowl, can thrive and reproduce in an agricultural setting. Constructive cooperation by farmers and ranchers, conservation organizations, and Government agencies can assure even greater abundance in America's rich wildlife heritage for the future.

The SCS considers that the encouragement of soil and water conservation which contributes to wildlife conservation on agricultural land is one of its important responsibilities.

Plant Materials Work

Since its inception SCS has been constantly searching for new plants with which to solve soil and water conservation problems. Early experience showed that widespread soil erosion and water loss were caused by cropping land not suited to cultivation, excessive use of row crops, incorrect tillage methods, and overgrazing of pastures and rangeland. In returning eroded lands to vegetation it was soon found that the available grasses and legumes were not good enough to do the kinds of jobs that had to be done. Thus, the search among native and imported plants was started and still goes on.

The first step is to assemble native or introduced seed and plants from foreign accessions or plant breeders at 18 Plant Materials Centers to determine their range of climatic and site adaptation for solving urgent conservation problems.

As a result of this work, nearly 100 kinds of improved grasses and legumes, unavailable in the past, now can be obtained on the market and put to use doing a better conservation job.

Watershed Program Activities

The Department of Agriculture's principal watershed activities on privately owned lands are those authorized by the Watershed Protection and Flood Prevention Act, Public Law 566, which is administered by the Soil Conservation Service. A total of 359 such projects were underway on October 1, 1961.

In addition, work is continuing on 11 watershed projects comprising about 30 million acres authorized in the Flood Control Act of 1944, and is nearing completion on some 54 pilot watersheds provided for in the USDA Appropriation Act of 1953.

Work under the 1944 congressional authorization began in 1946. It was soon determined that the only feasible approach was to divide the large watersheds into subwatersheds, and tackle the land treatment and construction measures small watershed by small watershed.

In 1953, the Congress appropriated $5 million with which pilot small watershed projects were started throughout the Nation under the basic SCS authority, Public 46, enacted in 1935.

One objective of the pilot projects was to demonstrate in representative areas of the Nation the benefits of combining soil and water conservation on the land with upstream flood prevention structures. The other was to find out the best ways to achieve local-State-Federal teamwork in planning and carrying out watershed protection and development.

Under this authority, 38 pilot projects have been completed, 7 are scheduled for completion in fiscal year 1962 and 6 in fiscal year 1963. Current schedules show 3 projects in operation after fiscal year 1963.

Few conservation acts have created as much popular interest and activity in such a short time as has Public Law 566. By October 1, 1961, local organizations had prepared applications for assistance under its provisions in some 1,700 watersheds. Applications had been approved by designated State agencies in

48 States and Puerto Rico, and had been transmitted to the Department of Agriculture. These applications cover more than 110 million acres. To provide more effective State and local participation in this program, the legislatures of 40 States had enacted more than 150 pieces of State legislation. Additional new legislation is being prepared for consideration by the legislatures of several States.

By October 1, 1961, the SCS had provided planning assistance to 680 watersheds containing more than 47 million acres. Based on completed plans, approved administratively or by congressional committees, as required, 359 projects containing about 21 million acres had been authorized for operations and an additional 28 completed plans were in the process of approval. Of these, 168 were under construction and 42 have been completed.

The popularity and support of the Public Law 566 program throughout the Nation indicates that it truly meets a long-felt need for organized action to fill a gap in national resource conservation and development programs. Prior legislation had provided, on the one hand, for programs of public land conservation and for technical, educational, cost-sharing and credit assistance to individual private landowners and operators. On the other hand, the Reclamation, Flood Control, TVA, and other Acts had authorized large programs of Federal development of downstream river resources, including large irrigation schemes, hydropower development, flood control, navigation and, secondarily, fish and wildlife development, recreation, and municipal or industrial water supply.

The gap left by these programs occurs in the small watersheds, generally those of less than 250,000 acres. The small watersheds have many of the same needs for land and water management that exist on the larger rivers. More than one-half of the flood damage in the Nation occurs in these upstream watersheds. A larger percentage of the irrigated farmlands of the West are within or get their water supply from small watersheds. Most drainage needs in the East are confined to small watersheds. Thousands of towns and small cities use surface water supplies from such watersheds. Fish and wildlife and recreational development must be greatly accelerated on small watersheds if the need for such development is to be brought within reasonable distance and cost to the average citizen. Many of the problems of erosion, as along water courses, or of phreatophyte control can be effectively solved only by public action programs in small watersheds. In fact, of all water resource developments only navigation and hydropower seem to be confined to, or even predominant on, our larger rivers.

The Public Law 566 program was a response to this need. Its fundamental principles are: (1) Local initiative and responsibility; (2) Federal technical and financial aid; and (3) State review and approval of local proposals with the wide-open opportunity for State financial and other assistance.

Estimates from the Department's National Inventory of Soil and Water Conservation Needs indicate the dimensions of the watershed job ahead. The reports show a need for project-type action on 75 percent of the total number of small watersheds delineated in the Nation.

These watersheds contain approximately one billion acres, or 55 percent of the Nation's land area. The inventory shows an estimated 63 million acres needing project action for flood protection in upstream watersheds, 14 million acres needing project action for irrigation, and 46 million acres needing project action for drainage.

Water Resource Activities and River Basin Investigations

Activities of the Department of Agriculture in the field of water resources that involve interagency cooperation and cooperation with States are carried out by SCS, with FS and ERS.

The Watershed Protection and Flood Prevention Act administered by SCS provides broad authority to cooperate with State governments and with other Federal agencies in river basin planning, surveys and investigations.

River basin surveys are undertaken at the request of the cooperating States or Federal agencies. They are valuable in maintaining coordination between the upstream watershed aspects for which USDA has responsibility and the downstream problems of water resource use and development. Cooperative river basin surveys and investigations provide a basis for coordinated resource developments. As a result of these studies, watershed projects are frequently found feasible and are subsequently planned.

Snow Surveys and Water Supply Forecasting

The SCS has Departmental leadership for conducting the snow surveys in cooperation with other Federal, State, and private agencies.

Most of the water for the Western States--for agriculture, industries, cities, power--comes from the snow that falls in the mountains.

How much water will be available is determined by snow surveyors who measure the water content of the mountain snowpack in the winter and estimate the acre-feet of runoff from each mountain watershed.

Data they collect are translated into a water supply forecast issued by the SCS, usually about mid-April. Water users of the West base their plans for the year's operations on this forecast. Interim reports are released from time to time during the winter.

Great Plains Conservation Program

The Great Plains Conservation program was authorized specifically by P.L. 1021, enacted in 1956. It is a long-term soil and water conservation program aimed at bringing about needed land-use adjustments and the application of enduring conservation practices.

In the Great Plains, an area of severe climatic hazards, various programs have been carried out at a relatively high cost in the past to meet emergency situations. The Great Plains Conservation Program is designed to bring about a more nearly permanent solution to the problems resulting from drought and the cultivation of low-grade cropland.

The program was recommended by the Great Plains Agricultural Council, by farm organizations, soil conservation districts, and others. Responsibility for administration is assigned to the SCS. Local leadership from soil conservation districts, without cost to the Federal Government, is largely responsible for the progress of this program.

Technical assistance and cost sharing are integrated in carrying out conservation plans over a period not to exceed 10 years. Cost shares are specifically limited to installing permanent non-recurring practices and are obligated at the time the plan is developed and the contract signed. This guarantees the availability of funds to apply the needed practices on schedule and to make the changes in land use that are required to cope with the soil and climatic hazards of the Great Plains.

Farmers and ranchers maintain all practices and, in addition, have been willing and able to carry out, as a condition of contract fulfillment, annual recurring practices such as stubble mulch farming and deferred and rotation grazing, without Federal cost shares.

Converting land unsuited to cultivated crop production from such use to grassland and the reseeding of depleted rangelands have top priority in this program. By July 1, 1961, about one-third of the 2.1 million acres of cropland in Great Plains Conservation program plans had been contracted for converting to grass along with the reseeding of over one-half million acres of depleted range. These practices, together with water conservation measures and the control of competitive shrubs, have meant the obligation of about three-fourths of the available cost-share funds.

Soil and Water Conservation Needs Inventory

The Department of Agriculture and cooperating State and local agencies are bringing to a conclusion a National Inventory of Soil and Water Conservation Needs.

The Inventory will provide the most thorough and objective picture we have ever had of the Nation's privately owned land and water resources for which the Department is responsible for carrying out programs of conservation.

The Inventory was initiated in response to a growing demand, both from inside the Department and from without, for this kind of information, which was not available from any source.

To meet this need the Department established in 1956 the National Inventory of Soil and Water Conservation Needs, set up an interagency committee to make the inventory and keep it current, and assigned responsibility for leadership to the SCS. Similar committees were established in every State and county.

A host of research councils, institutes, universities, chambers of commerce, river basin study organizations, and other public agencies have expressed a great interest in the use of the Inventory data. In addition, many commercial concerns, including fertilizer, farm equipment, irrigation, seed, utility, and other companies concerned with agriculture, are asking for information about production potentials and trends in land use.

Technical Services to ACP

Through the Agricultural Conservation Program of the Department of Agriculture, the Federal Government offers to share with farmers the cost of applying certain soil and water conservation measures. The national program is set forth annually in an Agricultural Conservation Program National Bulletin, and each State program through an Agricultural Conservation Program State Handbook. Also, county programs are set forth annually for each county in the United States.

State and county programs are developed to meet the soil and water problems in the State and county within the principles and policies of the national program.

The SCS is assigned responsibility to (1) help formulate the annual Agricultural Conservation Program at the national, State, and county levels, and (2) carry out certain technical phases of the program in the counties.

Effect of Existing SCS Programs on Resource Requirements and Potentials

In the following presentation, the effects of the combined program responsibilities of SCS are indicated. In some instances, the estimated portion of these effects that can be accomplished by a particular program responsibility is also given. Where practice data are shown, the cumulative totals are all-inclusive for the several program responsibilities as they apply.

Cropland

Acreages of Major Crops

The combined SCS program does not have the effect of increasing or decreasing the total national acreage devoted to major crops. It does influence the kind of land on which major crops are produced. The influence is in the direction of land better suited for production of major crops being devoted to that use.

Present Cropland Available for New Uses

The SCS program has only minor effect on net changes of present cropland available for other uses, but its net influence is in the direction of some shifts out of crops to other uses. Also it influences shifts among various land uses which result in land being used more efficiently and more in harmony with its capability, and, generally, in improved stability of agricultural enterprises. For example, about 13 million acres of steep-eroded cropland, much of it unsuited to the production of cultivated crops, have been converted to grass or woods in soil conservation districts during the last five years. Cropland converted to grass in soil conservation districts now averages about 2.5 million acres a year, and cropland converted to trees and shrubs averages about 500,000 acres a year.

The Watershed Protection program will be responsible for the conversion of substantial acres of present cropland to new uses. Especially important will be the increase in the acreage devoted to recreation, fish and wildlife. About 34,000 acres of land, of which 8,000 acres are presently used for crop production, will be converted annually to recreation, and fish and wildlife uses by sediment pools created behind floodwater retarding structures. Additional acres will be converted to these uses where capacity is provided for the specific purpose of recreation or fish and wildlife development.

Under 6,947 contracts in the Great Plains Conservation Program, acreage devoted to crops at the time of planning will be reduced by 28.3 percent, or 608,000 acres, during the period of these contracts. Most of this land has been, or will be, converted to range and pasture grasses under plans already developed. This is, of course, a small part of the total acreage of the Great Plains, but this shift in land use is highly significant in terms of proper land use on those farms and ranches affected.

Development of New Cropland

In compliance with Departmental policy SCS does not provide technical assistance to cooperators on drainage, irrigation, or land development jobs where the primary purpose would be adverse to this policy. The SCS program, therefore, results in the development of extremely small acreages of new cropland. Looking to the future, however, the SCS does have available a wealth of information to guide the development of new cropland when the need arises. The watershed program results in the use for crops of some flood plain land, perhaps 80,000 acres a year, now devoted to less intensive uses. Production of these crops is shifted from less productive upland areas and the shift facilitates the conversion of such upland areas to grass and trees.

Improvement of Existing Cropland

The SCS program has a major effect on improving existing cropland. These improvements are in the direction of increasing crop yields per acre and reducing the costs of production. The influence is through farmers and ranchers who plan and apply conservation treatments with SCS technical assistance. These conservation treatments go far beyond stabilizing the soil against excessive erosion and include, for example, fertility management and a number of practices that improve the ease of planting, crop establishment, and cultivation.

It is estimated that each year about 300,000 additional acres of existing flood plain cropland will be improved and protected by the watershed protection program. This improvement will come largely through the reduction of floodwater and sediment hazard.

Forest Land

Development of New Forest Land

The main influence of SCS in developing new farm woodlands is to assist private landowners in planning for the shift of other land to woodland uses. Land capability information is essential to that effort. Soils data are also necessary in recommending species adapted to different site conditions, and in delineating woodland sites on farms and ranches.

Soil conservation district cooperators in nearly all parts of the country are moving ahead with tree plantings, windbreaks, and farm shelterbelts on private lands converted from other uses. Adjustments on other parts of the farm or ranch are often necessary to make it economically feasible to convert certain lands to woodland.

Tree planting includes tree seedlings or cuttings in open areas, direct seeding, and interplanting--984,500 acres planted to trees on private land in soil conservation districts in 1960, bringing the total to about 9 million acres.

Field windbreaks include trees and shrubs planted in strips or belts--4,346 miles in soil conservation districts in 1960, bringing the total to about 43,000 miles.

The trend in tree planting in soil conservation districts is still upward. It is estimated that an average of about one million acres will be planted to trees annually over the next 10-year period. There is still much land in soil conservation districts, the permanent use of which is best suited to trees. For example, some part of the low quality land now used for cultivated crops, certain grazing land, and other idle or wasteland on farms and ranches, which should be converted to woodland. The National Inventory of Soil and Water Conservation Needs shows 72,683,000 acres of non-Federal land needing the establishment of timber stands in 48 States.

The watershed program will result in the development of new farm woodlands at the rate of about 110,000 acres annually. Some of these areas are poor quality cropland and others are largely idle and covered with brush. Most of them are critical silt source areas above reservoirs.

Improvement of Existing Forest Land

About 10 percent of the estimated acres needing timber stand improvement in soil conservation districts has been improved in recent years. The annual rate of such work by district cooperators in 1960 was slightly less than 2 million acres. This rate is in contrast with 159,280,000 acres needing timber stand improvement in the United States, according to the National Inventory of Soil and Water Conservation Needs.

The watershed program provides for the improvement of existing farm woodlands as specified in parts of watershed work plans. It is estimated that the average annual rate of improvement will be as follows: (1) Protection from grazing, 105,000 acres; (2) stand improvement, 108,000 acres; and (3) intensified fire control, 35,000 acres.

Pasture and Range

The SCS program is contributing significantly to increased forage yields and to increased acreages being devoted to forage production on both pasture and rangeland. Some development and improvement practices on these lands in soil conservation districts include:

Pasture planting--2,815,000 acres newly established in 1960, bringing the total to more than 32 million acres of new pastures.

Pasture improvement on existing pasturelands--1,953,000 acres in 1960, bringing the total to about 12 million acres.

Range seeding with improved native grasses and other plants--1,340,000 acres established in 1960, bringing the total to about 10 million acres.

Development of new pasture and range is estimated at an annual rate of about 210,000 acres as a result of the watershed program. The trend in the watershed program is to increase the acreage of pasture and range within projects by about 3 percent.

The enhancement of pasture and rangelands is an important objective of the Great Plains Conservation Program. The effect so far has been approximately 16.5 million acres of rangeland contracted for development and improvement. A total of 557,000 acres of rangeland have been seeded or planned for seeding on the 6,947 participating farms and ranches since the program began. Other improvement

measures include control of competitive shrubs and proper use of forage produced. Also, the 608,000 acres of cropland planted or to be planted to permanent grasses will become a part of the rangeland resource in the Great Plains.

Water Use

Expansion of Water Supply

The principal water supply facilities constructed with SCS technical assistance include farm and ranch ponds and irrigation reservoirs in soil conservation districts and single or multiple-purpose storage structures in the Pilot, P.L. 566, and Flood Prevention watershed programs. The estimated numbers, storage capacity, and surface area of these facilities constructed under the combined SCS program during 1960 and cumulative as of June 30, 1961, are as follows:

Structures	Number		Capacity (Acre-feet)	Surface (Acres)
	1960	to date	to date	to date
Farm and ranch ponds	58,400	1,117,000	2,603,000	774,000
Irrigation reservoirs	3,200	36,000	1,104,000	239,000
Floodwater detention str.	500	2,400	1/ 377,000	71,000
Total	62,100	1,155,400	4,084,000	1,084,000

1/ Permanent sediment pool storage only.

In 1960, about 62,100 water supply structures were installed with a capacity of about 313,000 acre-feet and having a surface area of nearly 77,000 acres. By 1980, it is estimated that 2,100,000 water supply structures will have been built. These will have about 2,520,000 acres of surface area, and contain more than 10,100,000 acre-feet of storage capacity.

The watershed program will significantly expand the supply of water for agricultural and other uses. It is the policy of the Department to encourage the development of multiple-purpose watershed projects by including storage capacity in reservoirs for irrigation, municipal and industrial water supply, fish and wildlife, and recreation.

The watershed program alone will make available an added 37,000 acre-feet of new water storage capacity each year. Of this amount, about 29,500 acre-feet will go to nonagricultural uses and the balance, or 7,500 acre-feet, to agricultural use.

Frequently use is also made of the water in sediment pools in floodwater-retarding structures even though the structures are designed to serve only a single purpose. This water is often used for irrigation, fish, and recreation activities. It is estimated that about 60,000 acre-feet of added capacity annually will be available for these uses.

The Great Plains Conservation program provides for expansion of water supply in the following important ways: Wells for livestock water; impounding reservoirs for livestock and other purposes; and irrigation reservoirs. A total of 656 wells, 1,388 livestock ponds, and 36 irrigation reservoirs had been installed as of July 1, 1961. (The livestock ponds and irrigation reservoirs are included in the above table.)

Improvement in Efficiency of Water Use

The SCS encourages the adoption of practices that will make efficient use of water nationwide. The practices are designed to reduce runoff and to get the maximum intake of water in the soil, such as terracing, contouring, stripcropping, proper management of crop residues, and cultural practices which leave maximum plant cover on or near the soil surface. Special attention goes to increasing efficiency of water use in those sections of the country where water is a limited resource. Practices emphasized include reducing transmission losses, reuse, water spreading, improving irrigation efficiency by adjusting time and amount of water application according to the needs of the crop, encouraging irrigation only on the soils suited to efficient irrigation, and the application of measures such as land leveling to improve uniformity of water application.

Following is a summary for three practices applied in soil conservation districts with SCS technical assistance:

Practices	Annual rate 1960	Estimated total June 30, 1961
Land leveling ----------acres--	383,085	6,400,000
Improved water application -acres--	1,705,079	12,250,000
Proper water use systems ---acres--	570,682	4,500,000

Another contribution to efficiency of water use is provided by the Cooperative Snow Survey. Through this effort, advance information is provided to show the seasonal water supply of numerous western streams. The surveys on snow courses in mountainous areas and other basic data provide the basis for frequent forecasts. The use of this information by water users allows efficient planning and use of available supplies. Kinds and acreages of crops can be adjusted at the proper time in accordance with the predicted water supply.

The watershed program improves the efficiency of water use through streamflow regulation, pollution abatement, and proper water use for irrigation both in terms of existing supply and in connection with the use of any new supply included in the project.

Improvement in the efficiency of water use is also a major activity of the Great Plains Conservation Program. Most of the contracts covering more than 18 million acres of land contain some type of practice designed to increase the efficient use of water on pasture, range, and croplands.

Crop Yields

The program of SCS, while primarily directed at stabilizing and improving the Nation's land, water, and plant resources, contributes to increased crop yield per acre. It is impractical, if not impossible, however, to estimate the effects of conservation alone. The shifts in production from one type of land to another, resulting from the use of soil survey information, as well as soil stabilization and improvement and more efficient water use resulting from conservation treatments, have contributed substantially to increases in yields per acre.

One of the primary agricultural benefits accruing to the watershed program is the increase in crop and pasture yields on areas benefited by structural measures. The structural measures have not been in place long enough to provide a precise measure of the actual effects on crop yields. There is no doubt, however, that under the program, yield increases will result for a number of reasons. Some of them are: Reduced flooding, improved application of irrigation water, drainage, shifts in land use from low yielding to more productive crops, and more intensive use of existing cropland.

Improved Practices

Fertilizer, lime, minor elements and the use of chemicals are considered wherever needed as a part of conservation planning, particularly in connection with the application of vegetative practices. Recommendations for the use of such materials are coordinated with the findings of State and Federal agricultural research agencies. Also, the SCS emphasizes the desirability of using the best plants available--adapted to the soil, climate, and particular needs of the farmer or rancher. Through its plant materials activities the SCS has contributed to the development and widespread use of plants especially adapted for erosion control and conservation practices in all parts of the country.

The planning, design, and application of soil and water conservation programs, the development of new farm and construction machinery, and the mechanization of farms are interrelated. The SCS has redesigned practices to fit the newer types of equipment and also has made suggestions to equipment manufacturers that have affected the design of farm machinery. The SCS has played a major role in the design of certain construction, seeding, harvesting, and other types of equipment especially suited to conservation work. The effect of these mutually supporting influences has been to move conservation work ahead more rapidly and to get the work done more efficiently and economically than would have been possible otherwise.

Soil and water conservation programs will continue to influence and be influenced by the use of fertilizer and other chemicals, mechanization, and improved crop plants. Their precise impact is not measurable with the data now available, but, without question, the SCS program will continue to stimulate greater use of each of these items.

Improvement of Efficiency of Livestock Use of Feed

Programs of SCS work in the direction of improving the efficiency of livestock use of feed. The principal effects are by aiding farmers and ranchers plan and apply conservation practices that will provide a proper balance of grain and roughage production, proper distribution of livestock water facilities, maximum length grazing seasons by proper selection of forage species, and proper forage use, including adapted and efficient grazing management systems. It is impossible to place a quantitative estimate on these contributions.

Summary

From the foregoing, it is evident that the SCS program is interrelated with several other programs of the Department of Agriculture and of other Federal Departments. The combined effects of these soil and water conservation programs have been to aid the stabilization of our land base to fulfill the future requirements of a growing Nation. This same land base, along with suitable supplies of water, will be of great benefit in the event of a National emergency. There will also be increases in the requirements for food, clothing and shelter, as our population continues to increase.

The effects of research, cost sharing, technical assistance, and farmer acceptance of enduring conservation practices have been nationwide. It is impossible, however, to place a specific value on the separate efforts of the agencies concerned. Each program has an effect, and each contributes to the overall development and improvement of our land and water resources. It must be remembered, however, that the effect of each program is to some degree affected by interactions with other programs. The magnitude of those annual influences, where they are shown, together with trends expressed above, should be considered in light of the interrelationships among agency programs within the Department.

THE AGRICULTURAL CONSERVATION PROGRAM

The Agricultural Conservation Program has stimulated millions of farmers and ranchers to begin their first use-experience with many soil, water, and woodland conservation practices, established in accordance with sound technical standards. During its quarter century this program has been one of the country's strongest and most extensive efforts to conserve our renewable natural resources--to build greater strength-with-use into our agricultural lands and maintain or improve their capacity to meet society's long-time requirements.

Cropland

Acreage of Major Crops

The Agricultural Conservation Program is authorized under sections 7-17 of the Soil Conservation and Domestic Allotment Act, of February 29, 1936. The agricultural policy and enumeration of purposes set out in section 7(a) are as follows:

> "It is hereby declared to be the policy of this Act also to secure, and the purposes of this Act shall also include, (1) preservation and improvement of soil fertility; (2) promotion of the economic use and conservation of land; (3) diminution of exploitation and wasteful and unscientific use of national soil resources; (4) the protection of rivers and harbors against the results of soil erosion in aid of maintaining the navigability of waters and water courses and in aid of flood control; and (5) reestablishment, at as rapid a rate as the Secretary of Agriculture determines to be practicable and in the general public interest, of the ratio between the purchasing power of the net income per person on farms and that of the income per person not on farms that prevailed during the 5-year period, August 1909-July 1914, inclusive, as determined from statistics available in the United States Department of Agriculture, and the maintenance of such ratio."

For the period 1936 through 1943, the program was operated to effectuate all five of the purposes enumerated. Two kinds of payments were offered farmers: (1) A payment for keeping the acreage of specified soil-depleting crops in compliance with base acreages or allotments for the farm, and (2) making payments to farmers to assist and encourage them for carrying out soil-building and soil- and water-conserving practices.

Beginning with the program year 1944, and each year since, the ACP has been limited to a program of soil-building and soil- and water-conserving practices. For the entire period since 1936, the authorities

of the program have been used to assist voluntary action by farmers to effectuate the specified purposes.

During the period 1936 through 1943, the program had both direct and indirect effects on the acreages of major crops. The direct effect was through the incentive payments offered farmers to comply with acreage allotments or base acreages, and the indirect effect was from the incentives offered to carry out various kinds of conservation measures. Beginning with 1944, and continuing to the present, the effect of the program on acreages of major crops has been limited to the indirect effects of farmers applying conservation measures to their land.

Development of New Cropland

The authorities for carrying out an Agricultural Conservation Program are very broad in the basic Act. During the present period, when we are faced with an abundant supply of many of the major crops, it is the policy of the program to limit assistance under the ACP to help achieve additional conservation on land now in agricultural production rather than to bring more land into agricultural production. Currently the program is not applicable to the development of new or additional farmland by measures such as drainage, irrigation and land-clearing.

In previous periods when it was in the public interest to increase agricultural production, the program was so used. For example, in the early days of World War II, expansion in the production of rice was extremely urgent and the program was adjusted to give additional incentive to increased acreages of rice. The conservation practices which resulted in an early increase in production also were stressed during the period. This is in contrast to the present policy to give added emphasis to those conservation practices which help farmers shift their land from intensive uses to less intensive ones, such as the establishment of trees and enduring vegetative cover. Many of the conservation practices carried out with ACP assistance contribute substantially to the shift of cropland to grass or trees, and to keeping noncropland from cultivation.

The principal conservation measures aiding in land-use adjustments that were carried out by farmers with 1959 ACP cost-sharing, amounting to a total of 5.6 million acres, are as follows: (1) 2.4 million acres of vegetative cover which keeps land out of intensive crop use for at least five to seven years and sometimes permanently; (2) 1.1 million acres of rotation grass or legume seedings which are in addition to the normal acreage of rotation cover on the farm and keep the land out of intensive use for at least two or three years; (3) 0.4 million acres of trees and shrubs planted for permanent retirement of farmland from field crops and pasture; and (4) 1.7 million acres of vegetative cover improved to bring it up to an acceptable conservation level and extend its normally expected lifespan.

Much of the land on which conservation cover was established was cropland previously producing at an intensive level. Much of the land on which the vegetative cover was improved would, otherwise, have been shifted to more intensive use.

Improvement of Existing Cropland

The Agricultural Conservation Program is presently operated to help achieve additional conservation on land now in agricultural production. Therefore, all conservation practices on cropland presently eligible for ACP assistance are designed to protect, conserve or improve it--but not to create new cropland.

The establishment of soil conserving vegetative cover, the construction of sod waterways and terraces, and conservation drainage are among the practices important to cropland for which the program offers cost-sharing assistance.

Forest Land

Development of New Forest Land

The Agricultural Conservation Program has contributed materially to a constantly growing appreciation for and use of farm woodland conservation practices. In recent years, the acreage of forestry tree planting receiving ACP cost-sharing has been growing each year.

The following table shows the extent of tree planting conducted with ACP assistance, 1936-1960:

Table 1.- Tree planting under the Agricultural Conservation Program
(Thousand acres)

Year	Extent	Year	Extent
1936	33	1949	96
1937	37	1950	119
1938	65	1951	113
1939	67	1952	101
1940	144	1953	80
1941	81	1954	116
1942	61	1955	150
1943	40	1956	195
1944	1/	1957	283
1945	18	1958	324
1946	44	1959	361
1947	45	1960	400 est.
1948	61		
Total		Total	3,033

1/ Practices not offered under 1944 ACP.

Improvement of Existing Forest Land

Improvement of existing forest land is recognized as one of the most important practices for which ACP cost-sharing assistance is offered. This program is carried out almost entirely on small privately owned forest holdings. Although this practice has increased greatly in recent years, the remaining need far exceeds the present rate of application. The following table shows the extent of timber stand improvement work conducted with ACP assistance from 1936 through 1960:

Table 2.- Timber stand improvement under the Agricultural Conservation Program

(Thousand acres)

Year	Extent	Year	Extent
1936	--	1950	30
1937	44	1951	21
1938	49	1952	21
1939	49	1953	29
1940	105	1954	76
1941	67	1955	133
1942	67	1956	199
1943	35	1957	228
1944	1/	1958	321
1945	2/	1959	304
1946	35	1960	350 est.
1947	74		
1948	22	Total	2,284
1949	24		

1/ Practice not offered.
2/ 156 acres.

Pasture and Range

A substantial portion of ACP assistance is used for conservation practices that benefit pasture and range land. These include, for example, livestock watering facilities to protect vegetative cover through a better distribution of grazing, the establishment and improvement of permanent vegetative cover, deferred grazing to permit natural reseeding, and the control of competitive shrubs on range and pastureland to improve the vegetative cover.

Water Use

Since the beginning of this program, ACP practices dealing with the management and conservation of water have ranked very high in areas where water supplies are limited. In planning for sufficient water for the country's current and long-range demands, its contributions to more efficient use of water and its direct conservation are significant. As new hydrologic and water management technologies are developed, the ACP stimulates and brings about their adoption on a large scale. They are used extensively in the great river basins where comprehensive water development and management are necessary to meet water requirements.

Illustrations of 25 years of ACP cost-sharing in the field of water conservation and management include these:

Vegetative cover established or improved.- A large acreage of various kinds of vegetative cover has been established or improved. Much of this in the nature of land-use adjustment over a substantial period of time. It increases water penetration, lessens runoff, and reduces erosion and siltation.

Tree planting and timber stand improvement.- More than 5 million acres of these forestry practices have been established. Most are on sloping land. In addition to the usual forest cover benefits, tree planting for windbreaks brings better utilization of snow moisture and reduces moisture loss from the protected cropland.

Terracing.- Terraces have been constructed on about 26 million acres. A current strong trend is toward level and spreader terraces designed to bring about additional water infiltration and permit little runoff and to parallel terraces that facilitate the use of modern farm machinery.

Water storage reservoirs.- 1.7 million storage-type reservoirs and numerous smaller water storage facilities have been built to permit or encourage livestock culture and the growth of protective vegetative cover.

Land leveling (forming or shaping).- Almost 7 million acres have been leveled, thereby reducing the amount of water needed for irrigation.

Contour farming and contour stripcropping.- 144 million acres have been served by these water conserving measures.

Other water conserving practices of less area extent but significant benefits include lining irrigation ditches and ponds, reorganizing irrigation systems, subsoiling, and pitting or contour scarification or furrowing of range and pastureland.

While the Agricultural Conservation Program is available for use on a voluntary basis on almost all types of land operated by farmers and ranchers, its use to accelerate watershed conservation programs sponsored by local people and organizations is being emphasized. ACP regulations and procedures provide that, when funds are allocated among counties, particular consideration shall be given to the furtherance of watershed conservation programs sponsored by local people and organizations, and that county programs shall give consideration to ACP cost-sharing in watershed conservation programs. Special emphasis is given to the use of ACP cost-sharing to accelerate the installation of on-farm conservation measures needed to protect watershed lands, water storage, and other structures involved in flood prevention or watershed protection, or other community-benefit types of water management projects. This is illustrated by these facts: Under the 1960 program alone, about $10.5 million of ACP cost-sharing was invested on 52,000 farms in three types of authorized watersheds.

Crop Yields

The Agricultural Conservation Program helps farmers carry out conservation measures needed to maintain or improve the capacity of agricultural lands to meet present and long-time food and fiber requirements. It helps to build greater fertility with reasonable, appropriate, and more efficient use of our agricultural lands.

Improved Practices

This program has helped to close the gap between the knowledge and the application of new and improved technology developed by research.

Some ways in which the ACP has helped translate this new conservation technology into public-serving uses are as follows:

1. New and improved varieties of grass and legume seeds have been made available. These survive better under difficult soil, moisture and disease situations and thus serve their conservation purposes. The ACP has publicized such seeds as eligible for cost-sharing when used to establish approved cover, sometimes at a premium credit rate because of their superiority over other varieties. It has, in periods of shortage, shared seed harvesting costs on some seeds.

2. Soil and mineral testing, in accordance with the best known techniques, have been required or strongly urged to bring about the most effective and economical conservation uses and benefits of such services and minerals.

3. Liming materials and commercial fertilizers are eligible for ACP cost-sharing assistance only when their use is a necessary step or component in the successful growth of conserving vegetative cover. Their use for these purposes has increased greatly under the program. For example, the use of agricultural liming materials was averaging around 3 million tons and did not ever amount to as much as 4 million tons annually prior to the ACP. With ACP assistance its use increased about tenfold, reaching 30 million tons annually in 1946 and several other years.

   The use of fertilizer for conserving vegetative cover also increased greatly under the program.

4. Numerous superior engineering and hydrologic techniques, associated with ACP earth-moving and water management practices, have been tested, proved on a mass basis, and rapidly made a part of the farmer's and rancher's good management.

5. Wind and water erosion inhibitors (vegetative and mechanical) have been used extensively on a wide variety of critical situations, to both the short and the long range advantage of our agricultural plant.

6. Soil-depleting and water-wasting brush and weeds on pasture and range lands have been repulsed in many areas. As new materials and techniques have been developed to meet these menaces to the economic life of the areas and the future welfare of the country, the ACP has greatly assisted with their introduction and successful use. The ACP has therefore been a principal stimulating, introducing and demonstrating ally of research education, and technology.

PRODUCTION CONTROL AND PRICE SUPPORT PROGRAMS

This section presents the effects on land and water use by acreage allotments, marketing quotas, the conservation reserve, and the wheat and feed grain programs.

Cropland

Acreage of Major Crops

Programs to control acreages devoted to crops of various kinds have been in effect for a number of years. As such, they have effectively controlled acreages in specific crops and retired from production to conservation uses considerable acreages of cropland. These programs include the following:

Acreage allotment and marketing quotas.- Acreage allotments and marketing quotas have been in effect for wheat, cotton, rice, and peanuts each year since 1954, and for the major kinds of tobacco since 1938. As a result, the acreage of these crops has declined nearly 29 percent since 1952-53. Producers have generally limited the acreage in these crops to their allotments in order to be eligible for price supports and to avoid a marketing quota penalty. The major shift in cropland use has occurred from wheat and cotton. Much of this acreage taken out of wheat and cotton, and the other crops under marketing quotas was shifted to production of other crops.

The acreage allotment crops in 1952-53 and 1960 and 1961 are shown in table 3. Until the inception of the conservation reserve and the 1961 feed grain program, the land taken out of these crops was used to grow other crops, including price-supported crops, particularly grain sorghums, barley, and soybeans.

The Conservation Reserve Program.- The authority to take new land into the conservation reserve program expired with the calendar year 1960. At the end of the signup of contracts for new acres in 1960, there were approximately 28.7 million acres of cropland entered in the conservation reserve. About 28.4 million acres remained under contract in 1961.

This land is pledged to the following conservation uses for the entire contract period: Protective grass and legume cover, 25,903,653 acres; planted to forest, 2,150,583 acres; water storage facilities, 16,625 acres; and specific wildlife habitat, 318,834 acres.

Table 3. - Acreage devoted to crops--1952-53 average, 1960 and 1961 with estimated acres retired under the conservation, and 1961 feed grain programs

(Million acres)

Item	1952-53 average	1960			1961 (preliminary)		
	Harvested	Allotment	Planted	Harvested	Allotment	Planted	Harvested
A. Crops under allotments and quotas:							
Wheat	69.5	55.0	54.9	51.9	55.0	55.5	51.4
Cotton	25.1	17.5	---	15.3	18.5	---	15.7
Rice	2.1	1.7	1.6	1.6	1.7	1.6	1.6
Peanuts	1.8	1.6	---	1.4	1.6	---	1.4
Tobacco	1.7	1/1.2	---	1.1	1/1.2	---	1.2
Total	100.2	77.0	---	71.3	78.0	---	71.3
B. Other price-supported crops:							
Corn	71.0	---	81.4	2/71.4	---	66.6	2/58.3
Oats	37.3	---	31.4	26.6	---	30.7	24.3
Barley	8.5	---	15.4	13.8	---	15.3	13.2
Sorghum grain	5.8	---	19.3	2/15.3	---	14.2	2/10.9
Rye	1.4	---	---	1.7	---	---	1.5
Soybeans	14.6	---	---	23.6	---	---	27.1
Flaxseed	3.9	---	3.4	3.3	---	3.1	2.7
Dry beans	1.3	---	1.5	1.4	---	1.5	1.4
Total	143.8	---	---	157.1	---	---	139.4
Total price-supported crops (A + B)	244.0	---	---	228.4	---	---	210.7
C. Other crops not price-supported	3/97.0	---	---	86.7	---	---	84.0
Total 59 crops	341.0	---	323.7	315.1	---	306.5	294.7
D. Conservation reserve 4/	---	---	---	21.2	---	---	21.0
Feed grain program 5/	---	---	---	---	---	---	20.6
Total	341.0	---	---	336.3	---	---	336.3

1/ Not directly comparable to acreage harvested, as some types are not subject to acreage restrictions. 2/ Harvested for grain. 3/ Includes sugar crop. Major use is hay (i.e., 1961 - 66.2 million acres). 4/ Excludes about 7.5 million acres in conservation normally devoted to hay, pasture, summer fallow, idle, or failure. 5/ Estimated on basis of preliminary reports from State ASCS offices.

It is estimated that immediately prior to being placed in the conservation reserve, these acres, with some consideration being given to double cropping, were devoted to the following uses according to preliminary estimates based on December 1960:

Former cropland use	Thousand acres	Former cropland use	Thousand acres
Corn	4,611	Sorghum grain	3,868
Wheat	3,176	Flaxseed	600
Cotton	682	Dry edible beans	81
Peanuts	132	Irish potatoes	35
Rice	7	Hay and pasture	4,938
Tobacco	11	Vegetables	218
Oats	3,938	Other crops	1,689
Barley	1,609	Summer fallow, idle, and failure	2,591
Soybeans	1,072		

The contracts expire on the 28.4 million acres remaining in the conservation reserve as follows:

Million acres	Expiration date	Million acres	Expiration date
2.2	Dec. 31, 1961	2.0	Dec. 31, 1966
1.1	Dec. 31, 1962	1.4	Dec. 31, 1967
7.4	Dec. 31, 1963	6.5	Dec. 31, 1968
3.6	Dec. 31, 1964	3.7	Dec. 31, 1969
.5	Dec. 31, 1965	1/	Dec. 31, 1970

1/ There are about 45,000 acres that represent a mandatory extension into 1970 because tree seedlings were not available during 1960.

The States placing more than 1 million acres of land in the conservation reserve are as follows:

States	Acres	States	Acres
Colorado	1,292,292	North Dakota	2,700,455
Georgia	1,055,866	Oklahoma	1,489,419
Kansas	1,447,166	South Dakota	1,820,502
Minnesota	1,894,228	Texas	3,649,682

Price support.- Another factor affecting cropland use is the price support program. However, since about 70 percent of the total land used for crop production, including hay, is devoted to price-supported crops, its effect on cropland use has been relatively small. In some cases, the price support programs may have increased production of some crops on some farms because of the assurance of minimum prices. In other cases, the price support programs may have resulted in some shift between crops depending upon the relationship of the price support levels. For example, the 1961 support price for soybeans, no doubt, was one of the factors that contributed to the 3.5 million acres of increase in 1961 over 1960.

Feed grain and wheat programs.- The 1961 feed grain program (P. L. 87-5, approved March 22, 1961) was designed to increase farm income, to prevent further buildup of the feed grain surplus, to reduce feed grain program costs to taxpayers, and help assure consumers of fair and stable prices for meat, poultry, and dairy products. The legislation provided for a 1-year voluntary program that called upon producers to reduce their 1961 corn and grain sorghum acreage 20 to 40 percent below the average of 1959 and 1960 acreages. Producers who participated in the program and diverted such acreages to conservation uses were eligible for payment. Only those who participated in the program by reducing their acreage of corn and grain sorghums by 20 percent are eligible for price support--not exceeding the quantity equal to their 1961 acreage times their 1959-60 average yield.

The Agricultural Act of 1961 (P. L. 87.128, approved on August 8, 1961) carried provisions for diverting to a conservation use, acreages normally devoted to wheat and feed grains in 1962. The basic provisions of feed grains in 1962 are essentially the same as for the 1961 program, the major exception being an expansion to include barley. Since the program is voluntary, it is impossible to estimate with any degree of accuracy the acreages which will be retired from production and diverted to a conservation use. However, it is generally expected that compliance will be about as large as in 1961.

The 1962 wheat program provides for a mandatory 10-percent reduction in the acreage allotments from those computed on the basis of a national allotment of 55 million acres for cooperators to be eligible for price support and not subject to a marketing quota penalty. Producers may voluntarily retire additional wheat allotment acreages to conservation uses. Most producers probably will comply with the first 10 percent qualification and thereby will reduce the acreage in wheat by about 5.5 million acres. A large number of producers also probably will voluntarily retire additional acreages to a conservation use.

In summary, the 341 million acres harvested in 1952-53 declined to about 295 million acres in 1961, and will likely decline to around 285 million acres in 1962. Most of this decline in harvested acreage is currently being devoted to conservation uses.

Improvement in Existing Cropland

Acreage allotment and price support programs.- The impact of acreage allotment programs on existing cropland came from shifting some land from allotment crops to another crop or use. Cotton farmers shifted land out of cotton into soybeans, feed grains, or pasture crops. Wheat farmers in the southern Plains shifted land out of wheat into grain sorghum, forage sorghum, other crops, or fallow. Wheat farmers in the northern Plains and the Pacific Northwest, shifted land out of wheat into barley, oats, minor crops, or fallow. Growers in the western wheat regions made no appreciable shift from wheat into forages for livestock.

On balance, these shifts have had no appreciable effect on cropland conditions. The poorer yielding land generally was shifted from allotment crops, whenever that was feasible. But this does not mean that this was the poorest land on the farm. It may have been in a still lower priority crop.

The shift from winter wheat or fallow to grain sorghum in the southern plains has caused some concern about the problem of wind erosion. Grain sorghum is a spring-seeded crop. Unlike winter wheat, it does not provide winter cover after a summer of tilled fallow. To overcome this, farmers are summer fallowing the sorghum land in a rotation wheat-grain sorghum-fallow. The winter cover problem is also present in north central Montana and in the Pacific Northwest where land was shifted from winter wheat on fallow to spring-seeded barley. However, erosion has not been mentioned as a problem in these areas. Winter barley is replacing spring barley in the Columbia River Basin wheat region of Oregon.

The Conservation Reserve Program.- This program, according to the tabulation given above, has removed about 13.5 million acres from the main soil-depleting crops (corn, wheat, cotton, soybeans, and grain sorghum). That is roughly 7 percent of the earlier acreages of these crops. The shift of land from corn, wheat, cotton, soybeans, or grain sorghum to a perennial grass cover undoubtedly has reduced the soil erosion on those acres, while the land is under the cover. Consequently, the average rate of erosion on total U.S. cropland has been reduced. The shift of 8 million acres from oats, barley, flax, vegetables, and miscellaneous crops, probably has had little effect on the rate of erosion on these acres. The 7.5 million acres shifted from hay, pasture, fallow, and idle would not be affected with respect to erosion.

While the Conservation Reserve Program has arrested erosion on contract land, it has not materially improved the land for crop production. Undoubtedly, some land has been improved under the perennial grass cover of the Conservation Reserve Program. Also, some insipient gulleys have healed over and, if given further treatment, will represent an improvement of existing cropland. But, the bulk of the land in the conservation reserve is merely standing by. Some of it will have a moderate buildup of nitrogen--about equivalent to the needs of the subsequent crop for 1 year. In the crop-fallow areas, the conservation reserve land will be sapped of soil moisture and will need 1 or 2 years to recover enough moisture to grow a crop.

The Conservation Reserve Program of 1958-60 was somewhat limited in its effect on improving existing cropland because the bulk of the contracted acreage is in areas of limited rainfall. A more compelling objective was to get land out of production.

The feed grain and wheat programs.- These programs will have the same effect on soil erosion as the previous acreage allotment programs, with the exception that the diverted land is put to a conserving use--for the one year. The estimated acres removed from corn and grain sorghum will arrest erosion on those acres, although success on the grain sorghum land will depend on successfully seeding a cover crop.

Extension of the feed grain program to barley and the new wheat program will divert additional acres to a conservation use, largely in the Plains wheat areas and the Pacific Northwest.

The feed grain program, operating as it does in reducing the acreage on all participating farms, will probably increase the deficit in some feed deficit areas, particularly in the western States of Arizona, California, Oregon, and Washington. These areas will have to ship in even larger quantities of feed grains--chiefly from the Plains areas which are the nearest source of supply.

Water Use

Acreage allotment and price support programs.- Cotton is the chief allotment crop grown under irrigation. In areas short on irrigation water such as the Salt River Valley in central Arizona, the west side of the San Joaquin Valley, California, and the High Plains of Texas, the cotton crop generally has been adequately watered; other crops such as alfalfa and grain were stinted. Cotton makes a more economic use, hence a more efficient use, of scarce irrigation water. In areas where there was not enough water for the allotted acreage of cotton, farmers attempted to grow the allotted acreage even with inadequate water. This may or may not result in an inefficient use of water. Abundant and cheap water is more likely to be used inefficiently.

Conservation reserve programs.- These programs, generally have not applied to irrigated land. Hence, they have had no particular effect on efficiency of water use.

Feed grain and wheat programs.- The chief areas where feed grains and wheat are irrigated are: Corn, in Nebraska and Kansas; grain sorghum, in the southern Plains; and wheat, in western Kansas and northeastern Colorado. But the entire acreage of corn, or grain sorghum, or wheat is not irrigated in any of these areas. Most farmers having irrigation also have some dryfarming. Hence, it seems unlikely that farmers required to cut back on their feed grain and wheat acreage, will have unused irrigation capacity. They will tend to fully use their irrigation facilities. "Stretching" of irrigation facilities is not generally evident in these areas. The acreage covered is adequately irrigated.

Crop Yields

Acreage allotment and price support programs.- Certain studies undertaken by the Farm Economics Division (ERS) have shown that acreage allotment programs have no discernable effect on yields of allotment crops. They found that the yields of nonallotment crops have increased at the same rate in the past 8 years. This finding is contradictory to a statement frequently heard that farmers apply more fertilizer and

other yield-promoting inputs when the acreage of a price-supported crop is restricted. However, the argument is contrary to economic logic: If larger applications of fertilizer pay after the restriction, they likewise would have paid before the restriction, provided the price of the crop has not changed.

Conservation reserve programs.- In the drier wheat areas, the conservation reserve program may reduce crop yields the first year or two after the land comes out of the program. In other areas, a modest increase in yield may occur--also for a year or two. No appreciable "buildup" effect can be expected on the conservation reserve land. The chief effect of the Conservation Reserve Program is to arrest erosion while the land is under contract.

Feed grain and wheat programs.- These programs tend to take the poorer yielding land out of feed grains and wheat in each county and on each farm. They will have no significant effect on subsequent yields of the land under contract.

THE FARMERS HOME ADMINISTRATION PROGRAM

The Farmers Home Administration is concerned primarily with farm people and the ways for people to make an adequate living on the land. Their welfare is best protected by wise land and water use. The Farmers Home Administration has encouraged better land and water use through farm management planning and supervision of its farm ownership loans, operating loans, water development and soil conservation loans, watershed loans, and emergency loans. One of the most important aspects of the FHA program related to land and water use is that no loan for crop production purposes is made without a farm management plan. When the loans involve such items as livestock and equipment to be purchased, and a longer than one-year repayment period, a long-range farm management plan is drawn in addition to the annual plan. Land use recommendations of the Soil Conservation Service are utilized in developing these plans whenever these are available.

Another important aspect of the FHA program is supervision by its local representatives to assure that the farm management plan is followed as closely as possible. This has an important bearing on proper land use; FHA encourages borrowers to plan for the best type of land and water use and, through control over the loan funds, is able to assure adherence to these soil and water conservation plans.

Since borrowers are required to finance elsewhere as soon as they are able, there is a rather rapid rate of turnover. Over the period of the last 25 years a large proportion of all farmers have been on FHA rolls at one time or another. During the drought and depression years of the 1930's, 80 percent of the farmers in some counties were borrowing from FHA's predecessor agencies at one time.

Cropland

Acreages of Major Crops

Changes in acreages of major crops occur as part of the programs of adjustment on individual farms. Sometimes changing conditions or changing methods of farming make it unprofitable to continue producing crops that have been traditional in a certain area, but lack of finances prevents some farmers from changing to better adapted, more profitable, farm enterprises. The FHA provides necessary financing in such cases for the purchase of equipment and livestock needed to effect such shifts in major farming enterprises.

The FHA and its predecessor agencies have loaned $5.5 billion to more than 2 million farm families during the last 25 years. Probably 90 percent of these people made changes in their crop program. Acreage affected would be a minimum of 180 million acres. A substantial part of these changes involved shifting away from cash crops and into forage crops and pasture enterprises.

Present Cropland Available for New Uses

In the southeastern part of the country there has been a substantial changeover from the production of cash crops to forage and grain for livestock production. This has frequently been financed by FHA loans. Conversion of cropland frequently occurs when farmers plant pasture crops on former cropland as part of a program of converting to livestock production. Conversion of cropland to forest lands has taken place on a limited basis.

Farmers Home Administration loans have enabled farmers to make shifts in farming programs to minimize risks in high risk areas. For example, many FHA loans are used to install wells and related land development necessary to assure production of forage and feed to stabilize livestock programs in the Great Plains and other low rainfall areas.

Development of New Cropland

A substantial number of Reclamation Project settlers borrow from the FHA to develop their lands for irrigation. In the last 10 years, 1,530 families on Reclamation Projects borrowed $26,363, 927 for various purposes, including $5 million for land development on 50,000 acres.

Predecessor agencies of the FHA developed projects involving 10,000 families on 1 million acres, much of it newly developed land.

Many of the loans to tenants for farm purchases involve funds for developing new cropland through clearing or leveling, digging irrigation wells, or sometimes for drainage. Operating loans to farm owners, or in some cases to tenants, frequently include funds for development of new cropland.

Improvement of Existing Cropland

In many parts of the country, the FHA has assisted in improvement of existing cropland primarily through its loans for soil and water development. These loans are made on a repayment basis up to 40 years at 5 percent interest. Such loans may be made to individuals or to associations of individuals, whichever arrangement is

the most economical. The improvements may include such items as land leveling and deep chiseling, but primarily these loans are for providing supplemental water through reservoirs, wells, sprinkler systems, gated pipe, etc. Drainage work on individual farms has also been financed by loans made for this purpose by the FHA.

In the last 6 years alone, FHA has loaned $44 million to 9,000 individuals and almost $11 million to 216 associations for soil conservation and water development purposes. This included money for irrigation development on a total of 798,000 acres and for drainage on 61,000 acres.

Total loans for soil and water development to individuals and associations over the past 25 years amounted to $85 million, affecting an estimated 26,000 farm families.

As a part of the careful farm management planning that takes place with FHA borrowers, it sometimes develops that a complete change in type of crop production will result in better land use on many individual farms.

Improvement of existing cropland is a natural outgrowth of improved tenure status. Since the tenant purchase program started in 1937, FHA and its predecessor agencies have loaned money to about 71,000 farmers to buy their farms and to over 9,000 farmers for enlarging their farms. Fee simple ownership of land enables borrowers to plan and carry out desirable improvements in the use of land and water resources. The farm unit reorganization program of the 1940's was a major effort to reorganize farm units to make the best use of soil and water resources.

Short-term credit with burdensome loan repayments sometimes forces farmers to engage in exploitative farm practices. Lack of adequate intermediate credit forces farmers into production of crops already in surplus or into farm practices that exploit soil and water resources. Because FHA loans for water development and soil conservation, as well as loans to cover the purchase of livestock and equipment, can be repaid over long periods of time, proper land and water use is advanced. This situation permits farmers to include desirable adjustments in land and water conservation and use.

Forest Land

Development of New Forest Land

The FHA makes loans to establish farm woodlots on a 40-year repayment basis at 5 percent interest. Restricted funds for all loan purposes may be one reason why more forestry loans were not made.

There are about 3.4 million commercial farm forests in the United States. Surveys have shown that these farm forests are in greater need of replanting and improvement than any other category of forest land. A Forest Service report entitled, "Timber Resources for America's Future," states that "...the commercial forest land in farms and private ownerships other than forest industries amounts to 296 million acres, or 61 percent of the total commercial forest area in the United States and coastal Alaska." "Largely as a result of the heavy cutting that has taken place on private holdings, the 73 percent of the commercial forest land in private ownerships supplies only 53 percent of the saw timber volume and about 59 percent of the total growing stock."

Some possible additional ways to stimulate forestry planting on privately owned farm woodlots are: (1) long-term loans at low interest rates, with deferments of principal and interest while the timber is growing; (2) tax concessions; or (3) rental of such lands by the Federal Government.

Improvement of Existing Forest Lands

Many farm forests are in need of improvement, but financial incentives are absent. The FHA is able to make loans for up to 40 years at 5 percent interest for improvement of existing forest lands. FHA records indicate that, in the past two years, [illegible] loans provided funds for forestry practices on 4,851 acres. This would undoubtedly have been a larger figure if more FHA loan funds and more encouraging financial incentives had been available.

Pasture and Range

The FHA makes long-term 5 percent loans for development and improvement of pastures and rangeland. During the last six years, pasture and rangeland improvements on 139,000 acres were financed with soil and water loans. This includes such items as fencing, contour chiseling, seeding, water spreading devices, check dams, and other irrigation facilities.

Association loans have been made to 36 soil conservation districts for the purchase of heavy equipment. Some of this equipment is used for pasture and range development and improvement. Loans are sometimes made to a master borrower to purchase such heavy equipment; individuals then hire this person to do custom work. Some of this work is for pasture and range development and improvement.

An estimated 207,000 ranchers have received FHA loans over the years for various purposes, including rangeland and pasture improvement.

Water Use

Expansion of Water Supply

Loans by FHA to individuals and associations have made possible the development of annual supplies of more than 1 million acre-feet of irrigation water in the United States during the period 1955 to 1960. These loans are made for terms of up to 40 years and at interest rates of a maximum of 5 percent. No records are available on development prior to 1955 except that about $30 million was loaned under the old water facilities program between 1937 and 1955. A considerable amount of this money was for expansion of water supply.

Many rural areas have always been faced with the problem of inadequate water supplies for domestic purposes. This inadequacy results from high concentrations of alkalai salts, pollution, undependability, and insufficiency of supply. In some cases, the alkalai concentration in the domestic water restricted even the growth and feeding of livestock and the production and handling of milk. Sometimes, the pollution of domestic water from surface drainage threatened health conditions in the homes. Farmers sometimes hauled their drinking water in tanks from good wells many miles away.

In recent years, new kinds of pipe have been developed that are much cheaper and that can be laid much more quickly than the old types formerly used. It is now economically feasible to pipe water longer distances than was the case in years past. Farmers are forming associations in many areas of the country to pipe good domestic water to their farms from a common adequate source. This development can be compared to distribution of electricity through REA cooperatives.

Associations are the most economical way of developing domestic water supplies because the best sources, from the standpoint of purity and adequacy of supply, are generally quite expensive to develop. The same limit applies to chlorination and filter treatment, where necessary. Thus, the availability of low-cost pipe has brought into the foreground the possibilities for group approaches to the domestic water problem. Advantages from these developments accrue to farm families, to schools, and to businesses and manufacturing industries such as creameries and canneries.

Improvements in well-drilling equipment, casings, and pumps have also brought individual domestic water wells and pressure systems within the range of many rural families in recent years. Under the soil and water facilities programs, an estimated 12,000

families were enabled to develop their own individual domestic water systems. An estimated 97,000 families were helped in providing individual water systems with funds from farm ownership, operating loan, housing loan, and individual soil and water conservation loan programs. Where the population density is still too low to warrant a common distribution system and where depth to adequate water supply is within reason, individual domestic water developments are still the best approach.

The FHA has made loans to associations for soil and water development and conservation over the past 22 years. These loans were made for as long as 40 years with interest rates not to exceed 5 percent. Before 1954 this program was limited to the 17 Western States. Available funds have always been limited. Table 4 shows the increased demand for these loans in recent years.

Table 4.- Soil and water conservation loans made to associations for domestic water supply systems

For 5- year period ending June 30	Amount loaned	Estimated number of families served
1940	$ 1,600	5
1945	227,582	364
1950	849,900	982
1955	4,142,950	3,734
1960	6,217,615	4,643
Period June 30, 1960 to October 15, 1961	3,181,615	2,272
Total	$14,621,627	12,000

Total loans for all purposes by the FHA and its predecessor agencies, including the figures quoted above, amount to $5.5 billion.

Improvement in Efficiency of Water Use

The FHA makes loans for such purposes as canal lining, sprinkler irrigation, gated pipes, and other types of irrigation installations that improve the efficiency of water use. Also in this category are loans for land leveling, terracing, and contouring. These improvements reduce the cost of applying irrigation water and also make the water go farther, thereby increasing yields per unit of water. They enable the farmer to apply water in the right amounts and at the right times, both of which are conducive to increased yields.

Crop Yields

Farm Home Administration supervisors work out farm and home management plans with each individual farmer and his wife. These plans draw on the practical experience of the farmer and the technical knowledge of the supervisor to use the loan funds in such a manner as to assure the most economical increase in production per acre consistent with good land use. The technical advice of soil conservation specialists is sought, as well as that of county agents and other agricultural experts. Once the plan is drawn, the county supervisor is responsible for seeing that it is followed by the borrower. Thus, with adequate financing and farm management supervision, FHA borrowers are able to keep pace with the record high crop production averages achieved by American agriculture as a whole in recent years.

Small Watersheds Program

Under the small watersheds program authorized by Public Law 566 and Public Law 534, the FHA is authorized to make loans to sponsoring local organizations to pay their share of the cost of the project development. Under this program, $4.9 million has been loaned on projects where benefits will include drainage improvement on 115,000 acres, flood protection on 164,000 acres, municipal water storage of 42,000 acre-feet, and irrigation storage of 5,000 acre-feet. The major portion of the cost of this work, however, is provided by Soil Conservation Service grants.

Improved Efficiency of Livestock in Use of Feed

The latest improvements in livestock production practices are made a part of the borrower's program whenever this is financially feasible. In some areas, particularly in Kansas, the FHA, in cooperation with local bankers, is providing funds to help farmers market their feed crops through livestock rather than for cash. Various types of livestock growing and fattening operations are conducted through this cooperative program.

Improved Practices

Fertilizers and chemicals based on soil tests, as well as improved mechanization and improved varieties, are incorporated in the farm plans whenever financially feasible.

Summary

The supervised credit program of the Farmers Home Administration will continue to improve land and water use through loans to individuals and associations. During the last several years, there has been a tendency to minimize the FHA program and many farmers lacked knowledge of the services available through this organization. With an increase in the willingness to serve farmers, it is expected that a larger number will use this service and that operations will expand.

A significant increase in operations in the direction of land and water use in the next 20 years will probably occur in the area of loans to individuals and associations for soil and water development, and particularly in the field of development and distribution of domestic water supplies. It is estimated that some 3 million rural dwellings still have unsafe or inadequate domestic water supplies. Reports from field offices show that at least 964,000 farm families will require loans totaling $718 million for improving domestic water supplies between now and 1980. Authorizations contained in the Agricultural Act of 1961 make it possible to render most of the services needed. Some revisions may be needed in legislative authority, and there should be an increase in annual appropriations to come closer to meeting the indicated needs.

An area in which the FHA could expand to a significant extent in the next 20 years, is in loans for forestry planting and improvements. The FHA is prepared to make loans to farmers for establishing and improving farm woodlots, provided annual appropriations are increased. For example, a 2-percent, 40-year, forestry loan with provisions for deferment of principal and accrued interest up to 25 years would stimulate more improvements in farm woodlots.

The FHA will continue to be an instrument which can and will effectively implement basic agricultural policy through loans for soil and water uses that are in line with Department policy.

THE NATIONAL FOREST PROGRAM

National Forests are Growing in Importance

The National Forests and National Grasslands of the United States are invaluable national assets. These Federal properties, amounting to 186 million acres, are clearly destined to receive more and more demands for water, timber, forage, wildlife and recreation use in the next few decades. The size, location, and character of the National Forest System assure its continued importance and increasing potential to meet a sizeable share of the total national demand for all forest products and benefits.

Until recent years, the National Forests have been remote or difficult to reach and use has been relatively light. Costs of management and protection under earlier programs were relatively low and revenues produced were of little significance. In the past 10 or 15 years, however, management has not been able to keep pace with public pressures for use of these resources. Expanded efforts are needed to realize a proportionate share of the Nation's total resource needs from these forests and grasslands.

Multiple-Use and Sustained Yield are Keys to National Forest Management

Traditionally, management of National Forests has had the objective of providing for the greatest good of the greatest number in the long run. This means protection and orderly development of all resources and their coordinated use at a sustained high level to meet both current and future needs of the American people. This principle was re-established by passage of the Multiple Use-Sustained Yield Act in 1960. Application of these twin concepts on a situation-by-situation basis insures that each resource receives equal consideration in making on-the-ground management decisions. On a broader scale they provide the framework for specific overall management objectives, policy guidelines, and action programs for each resource.

Stepped-up management of the National Forests to meet rising pressures presents both an opportunity and a challenge to refine and intensify application of multiple-use and sustained-yield principles.

Watershed Protection is a Fundamental Purpose of the National Forests

On a nationwide basis, the demand for water is expected to double or even triple in the next few decades. Already critical water shortages have limited economic and other development in some areas. Over half of all water flow in the West originates on National Forest lands

and, even in the East, National Forest land purchased under the Weeks Law of 1911 has considerable watershed significance. Western agriculture and industry are, to a large degree, dependent upon water flow from the National Forests.

A primary management goal is to maintain all National Forest watersheds in optimum condition to avoid excessive runoff, to increase total yields, and to maintain or improve water quality. An accelerated program of watershed management, rehabilitation, and protection is needed to assure achievement of that goal.

National Forest Timber Production Must Expand to Meet Future Requirements

National Forest timber supplies must keep pace with the rising trend of wood consumption clearly foreseeable in the next few decades. It is expected that the National Forests must provide about one-fifth of the Nation's total timber needs in the future. Meeting this need on a sustained-yield basis will require a much expanded timber production program which must reflect the rising tide of other demands upon the forest as well as the long period of time required to produce sawlog crops. Timber growing stock must be built up in terms of both volume and quality to provide an adequate base for sustained yields of timber products and to utilize site capacity with optimum effectiveness.

Range Resources are a Major Part of the National Forest System

National Forest livestock range is of major importance to a large segment of the western range livestock industry. The development and management of some 68 million acres of rangeland in the National Forest System is aimed at full production of livestock forage with due regard for other resources and uses. On a national basis, however, National Forest rangeland contributes only a small fraction of total livestock production.

National Forests are America's Playgrounds

National Forest recreation use is increasing at a phenomenal rate without sign of slackening. The number of recreation visits is expected to exceed 100 million in 1960--about 10 times as many as visited the National Forests in 1945. By 1980 it is expected that recreational use of the National Forests will be three times current use and that possibly 10 percent of the Nation's total demand for outdoor recreation will be met by the National Forests. The prime objective in management of the recreational resources of the National Forests is to achieve adequate development and maintenance to keep abreast of the tremendously increased demand. Millions of people find rest, relaxation and spiritual uplift in visits to the National Forests and it is clearly essential that these public lands continue to serve that purpose.

Wildlife Populations Rely Upon National Forest Habitat

The increasing use of the National Forest for recreation is reflected in greatly increased hunting and fishing pressures on these areas. Some 81,000 miles of fishing streams and more than 2 million acres of natural lakes and impounded waters constitute a major foundation of sport fishing. In addition, more than one-third of all big-game animals in America are in the National Forests. The primary objective of wildlife management on the National Forests is to create and maintain fully productive habitat conditions that will contribute most to public use and enjoyment of fish and wildlife populations.

Protection and Development Highlight Current National Forest Management

Protection of the forests from fire, disease and insect damage has been a continuing effort since the inception of the National Forest System. Annual losses from these destructive agents are still staggering despite the great progress that has been made in the past half-century. Inventory and growth losses are high, the quality of the various resources is lowered, and use of the forest is disrupted by the impact of those forces upon the forests. Additional resources to cope with critical fire periods, expanded efforts to reduce insect and disease losses and more intensive management will be needed in the decades ahead.

Stepped-up development of the National Forests holds the key to their adequate performance in meeting increased demands of all kinds. For example, the present 162,400 miles of roads in the system is only about one-third of the total needed to fully utilize all resources of the forest on a continuing basis. Similarly, there is still much to be done in consolidating ownership within the boundaries of the 155 National Forests through land exchange or acquisition. Administrative structures, fire-control improvement, and facilities for public recreation use are other areas where much work is needed to develop the National Forests on a systematic and planned basis.

National Forest Programs are Sound Investments

Many of the benefits and values of the National Forests, such as water yields and outdoor recreation experiences, are literally priceless. Yet, others such as timber and forage production can be assigned economic values. For example, cash receipts in 1960 from timber sales and other uses reached an all-time high of $148 million. The timber harvest totaled 9.4 billion board feet or 14 percent of the Nation's total and more than half a million big game animals were taken by hunters on the National Forests.

Direct financial revenues from the National Forest System, and indeed almost all benefits and values, closely reflect expanded programs and investment in these public lands. For example, under the "Development Program for the National Forests" recently submitted to the Congress, current receipts would nearly double in 10 years. Much of the development work, such as roads, trails, campgrounds, tree planting, etc. has a lasting value for many decades.

Mounting and competitive pressures for land by a rapidly growing population and expanding economy clearly require sound and balanced programs to fully develop this important segment of our natural resource heritage.

STATE AND PRIVATE FORESTRY PROGRAM

The Forest Service under direction of the Secretary of Agriculture, is responsible not only for applying sound conservation and utilization practices to the natural resources of the National Forests and National Grasslands, but it also has the responsibility for promoting these practices among all forest landowners through example, cooperation, research, and the dissemination of information.

State and Private Forestry Is a Well-established Cooperative Undertaking

In carrying out its responsibilities in State and private forestry, the Forest Service works with State foresters to assist private owners through a wide variety of cooperative forestry programs.

In 1898 the USDA offered the service of forest technicians to aid forest landowners and in 1908 Congress directed the Secretary of Agriculture to aid in enforcement of the laws of the States and territories with regard to fire prevention and control, protection of fish and game, and similar activities. The Weeks Act of 1911 provided for Federal-State cooperation in fire control. Section 2 of the Clarke-McNary Act of 1924 authorized the Secretary of Agriculture to enter into cooperative agreements with States for the protection of State and private forests against fire. These basic laws, later amendments, and the Cooperative Forest Management Act of 1950 provided also for cooperation with States in the production and distribution of planting stock for windbreaks, shelterbelts, and farm woodlands, and for general technical forestry assistance to States, community and private agencies, and others.

Other major programs involving State, Federal and private forestry cooperation include: the White Pine blister rust control authorized by the Lea Act of 1940; forest pest control under the Act of 1947; and the Conservation Reserve program, and the Title IV Forestation program under the Agricultural Act of 1956. In addition, several broad conservation programs include significant cooperative forestry efforts. The most important of these are: Agricultural Conservation Program of 1936 (including the Naval Stores Program); Flood Control Act of 1944; Watershed Protection and Flood Prevention (PL-566), 1954; and the Rural Areas Development Program of 1961.

About 391 million acres or three-fourths of the Nation's commercial forest land is in State, industrial, farm, and other non-Federal ownership. More than 90 percent of this area is in private ownership and two out of every three of these acres are in small private holdings. Cooperative Federal-State forestry programs are therefore largely directed to helping these small private forest landowners plant, grow, protect, and market their timber. In 1961 small forest owners in 2,198 counties were provided with technical and other assistance under the various cooperative forestry programs.

Fire Damage Greatly Reduced through Cooperative Action

The Forest Service cooperates with 48 of our 50 States in protecting 455 million acres of non-Federal forest lands from fire. This cooperative fire control program is one of the best examples of effective Federal-State-private cooperation. Since the passage of the Weeks Law in 1911, nationwide forest fire prevention campaigns and coordinated team work by the Forest Service, State foresters and individuals have markedly reduced the number of fires and the forest acreage burned. In addition to the combined efforts of the Forest Service and the State foresters in organization, training, research, prevention and suppression, the Federal Government contributes funds to State organizations on a matching basis to implement the program. Prevention of fire damage has resulted in widespread benefits to wildlife, recreation, range, and watershed values in addition to saving millions of dollars' worth of timber from destruction.

Timber Losses from Insect and Disease Attacks Lessened by Cooperative Action

The foundation of The Forest Pest Control Program is cooperative State, Federal, and private detection efforts, directed by the Forest Service, to discover destructive outbreaks of insects or disease epidemics. Such surveys are conducted periodically and cover all of the forested land in the Nation. Like fire, insects and disease do not respect property lines or ownership patterns and thus pose a common threat to all concerned. Evaluation of potential damage and coordinated suppression work follow detection of serious outbreaks. Generally, costs are shared by all concerned according to the character of each situation or project. The White Pine Blister Rust Control Program is another example of such cooperation. Although these programs are newer and smaller in size than cooperative fire control work, substantial progress has been made in reducing damage from white pine blister rust, spruce budworm, bark beetles, dwarf mistletoe, and other destructive agents.

Cooperative Reforestation Programs Have Put Millions of Idle Acres to Work

Many nurseries have been established through the cooperative efforts of the Forest Service and the State foresters in the Clarke-McNary Planting Stock Program and the Conservation Reserve Program. Billions of trees from these nurseries have been supplied to private landowners at nominal cost. Almost 1½ billion trees are produced annually through cooperative efforts.

Planting of trees is also a major cooperative forestry effort to reforest inadquately stocked forest land. Under the Agricultural Conservation Program, which is primarily directed to non-forest farm lands, 2½ million acres have been planted to trees. In addition, similar cost-sharing efforts under the Title IV Forestation Program have resulted in planting or seeding about 65,000 acres of forest land. In most cases, the Federal Government contributes about half of the cost of planting.

Soil bank planting of trees on cropland under the Conservation Reserve Program has resulted in forestation of about 2¼ million acres previously in crop production. Planting under this program ceased in 1960.

State and Federal Cooperation Has Improved Forest Management

Forty-six States employing 700 foresters are now actively cooperating with the Forest Service under the Cooperative Forest Management Program. Farm foresters provide technical services and advice on cutting methods, timber-stand improvement, marketing, reforestation, processing, and other activities to about 80,000 landowners each year under this program. Educational and information services are other significant cooperative ventures leading to better management of State and private forests.

Under the Agricultural Conservation Program previously mentioned, two million acres of timber have been improved by various cultural treatments on a cost-sharing basis. Elimination of diseased and cull trees, thinning and release of young timber growth, and similar improvement work has increased tenfold since 1950.

The Naval Stores Program administered by the Forest Service is a specific cooperative effort to achieve better methods of harvesting naval stores. Cost-sharing benefits based on improved practices have been effective in changing widespread destructive methods. Recommended practices lead to a permanent well-founded industry integrated with other wood-using industries and to increased financial returns to forest owners. At present, 65 percent of naval stores producers are operating under this program and meeting requirements regarding fire protection, cutting practices, and other conservation measures.

Forestry Is Important in Many Broad Conservation Programs

Federal-State-private cooperation in conservation efforts ranges far beyond forestry programs as such. Almost all such efforts, however, encompass some forestry activities. The Agricultural Conservation Program and the Conservation Reserve Program already mentioned are examples of broad programs with real forestry significance.

Flood prevention and land treatment work under the Watershed Protection and Flood Prevention Programs (P.L. 566 and the Flood Control Act of 1944) are aimed primarily at prevention of damage from soil erosion, flood water and sedimentation. Ultimately, however, the program will also have significant forestry values. About $4\frac{1}{2}$ million acres of land have been placed under improved forest management, fire protection, or planted through watershed program activities. Similarly the new Rural Areas Development Program may well prove influential in improving local economies as a result of resource development and use.

Current Programs Still Inadequate to Meet Future Needs

The existing cooperative forestry programs and current independent efforts are impressive. Although upward trends in independent reforestation and timber-stand improvement plus stepped-up cooperative Federal-State-private forestry programs should achieve noticeable improvement in the timber situation on small private holdings, it is clear that much greater accomplishment is needed to increase the productive condition of small holdings sufficiently to insure adequate future timber supplies for the Nation. Related cooperative programs dealing primarily with agricultural and water resources, wildlife habitat, and rural development also need to be strengthened in the years ahead.

FEDERAL-STATE COOPERATIVE EXTENSION SERVICE PROGRAM

The Federal-State Cooperative Extension Service has helped farmers throughout the Nation learn about the importance of conservation and the best use of resources, including soil and water resources, through a self-help, learn-by-doing educational approach. Most basic has been the better farming and homemaking practices that make conservation and sound resource use possible and profitable.

The story of American agriculture has been one of growth--of technological changes--that have come with bewildering rapidity. Extension agents have helped farmers keep abreast of and adjust with these changes.

Farmers have learned to use machinery effectively, to use new crops, and new crop and livestock production and conservation practices. They have been helped to study outlook and other economic facts, and make marketing, management, and community and area cooperation adjustments that have been basic to soil, water, and other resource use. In other words, greater understanding through education has brought, and is bringing about, wiser use of our land and water and other resources.

Localized Education

Farmers and communities change their ways of using land and other resources if they believe it is to their advantage to do so. Extension agents have made heavy use of demonstrations and voluntary local leaders to help farmers see the advantages of better practices. They work closely with farm organizations, industry, civic and many other groups, and public agencies. They use the press, radio, television, tours, and many other methods in making farmers aware of new opportunities, adjustments, and economic and social facts they must have to do a sound job of decision making.

Teamwork Approach

The earlier sections of this report have outlined many far-reaching programs in which extension agents have played a major role as the educational arm of the U. S. Department of Agriculture. This link of Extension agents, operating in almost every county, with the Department, together with their ties in the State Land-Grant institutions and their joint employment by the county as well as the State and Federal Government, is a major strength.

Most soil, water, wildlife, recreation, and other resource development and conservation programs involve local, as well as State and Federal facts, support, sponsorship, laws and other considerations and relationships. Because of their joint County-State-Federal employment, extension agents are in very special positions to help the local people draw on the many agencies involved. At the same time they give educational support to these agencies.

Leadership Development

While extension agents have made basic direct contributions on the land and in community action, one of their most basic contributions has been in the development of local leadership. The 22 million boys and girls who have participated in 4-H Club leadership, conservation and other projects are taking their place as today's leaders. The one-quarter million local leaders, who help plan and carry forward extension programs each year, receive much training and experience that equip them for leadership in other areas. A major extension role in community improvement, rural areas development, and other programs is the location, motivation, and development of local leadership.

On the Farm

Farming has grown to be a complicated, high investment, specialized business. Farmers increasingly face pressing adjustments that basically influence their use of land and other resources. These adjustments are necessary to improve farm income and maintain continued economic growth and progress.

To make them, farmers must have the best of locally applicable technical and economic information. To help meet these problems extension programs have become more specialized. Extension agents are putting much greater emphasis on the management phases of farming.

Thousands of farmers, scattered throughout the land, have demonstrated in convincing fashion that they can buck the tide of low farm income and adjustment through a program of Farm and Home Development or Better Management. Extension's task has been one of helping the farm family bring together and analyze all the facts and alternatives, set goals, and decide on how these goals can best be obtained. This has resulted in many adjustments that bring about better use of resources and in some families moving to other occupations.

On many soils minimum tillage and new and better methods of weed, insect, and plant disease control have reduced the emphasis on crop rotations. Management of crop residues, such as stubble mulching, has

received increased attention. Extension agents and specialists demonstrate to farmers how this improvement in land management can be made at little cost.

Extension programs often use contests to set goals. Experience has been that these goals soon become averages and new levels of production efficiency are set.

Two million soil tests each year help farmers determine the amount of lime needed and select the fertilizer best suited to the particular soils and crops.

Forage testing is now emphasizing the value of good roughage. This is resulting in a chain reaction with more attention to quality of feed, better feeding, and better use of land for forage crops. Research results and experience have shown the value of improved grasses and better management of pastures, and Extension agents are helping farmers make major livestock, soil, and water conservation improvements through good pasture management.

Rural Areas Development

The Cooperative Extension Service and other agencies are now giving major attention to rural areas development. This is essentially a program of community redevelopment and economic growth through more effective use of all resources in the area--land, water, forest, industry, mineral, recreation, human, and other resources. Extension's major role is one of organizational and educational leadership.

The first major job is one of motivating and helping the people of the community see the possibilities and organize for action. Extension and many other agencies are helping the local leadership bring together and analyze the facts about total area resources, study alternatives, and develop and carry forward their own area development programs.

This is a total approach to the problem that involves a pooling of many special programs and other assistance to the area. It has important agricultural resource implications.

Public Understanding

Many of the problems in conservation and development of our soil, water, and other agricultural resources go beyond the farm and rural area. They involve much wider public understanding by the 90 percent of the people beyond the farm, as well as by farm people. This is essential both in the very broad phases of national and local public resource policy and in

the more local development of specific watershed, recreation and other resource development areas.

Extension workers have an increasing challenge in the area of public affairs education. Through farm-city leadership meetings, self-administered and other discussion groups, special efforts with non-farm and farm opinion leaders, use of mass media, and in other ways, Extension agents and specialists are making increased efforts to get better public understanding of the facts and alternatives.

In all of these areas the story of extension work has been one of change--to help the people apply science and experience to changing problems. The job today is a major adjustment one. Helping farmers make most effective use of soil and water and other resources is most basic. Helping spread the improved better farm technology and management practices that make this possible and profitable is also most fundamental to effective extension education.

THE RURAL ELECTRIFICATION ADMINISTRATION PROGRAM

The Rural Electrification Administration furnishes financial and technical assistance to local entities organized to furnish central station electric service and telephone communications service to both farm and nonfarm establishments in rural areas.

From 1935, when REA first commenced electrification lending operations, to date, the national percentage of electrified farms has risen from 11 to 97. About half of the increase is associated with REA financing. Commercial and publicly owned electric utilities account for the balance.

It would be highly conjectural to attempt to measure exactly the effects of REA programs upon land and water resource requirements and potentials. REA itself operates no facilities and must rely on borrower reports for operations data. Where available, electric industry-wide statistics which have some relevance are presented. Such telephone data as are available are not useful as measurements here.

Effect of Electrification Upon Farm Operations

To a very considerable extent, the electrification program of REA and other segments of the electrical industry has made possible the substitution of electric energy for manpower in agricultural operations. No exact data are available which measure the extent of this substitution. The supplanting of manpower by electric energy on the farm is recognized as an important factor in encouraging diversification of farm product on individual farms, e. g., commercial livestock, poultry, and dairy operations made feasible through electric brooders, milkers, coolers, feeders, and environmental controls. A considerable portion of the electric energy consumed on farms is used in and around the farmstead. The application of electricity to better utilization of cropland and the development of new cropland is largely represented by electrically operated irrigation pumping.

The extent of increase in the utilization of electric energy on farms from 1935 through 1959 is shown in the following table.

Table 5.- Farm consumption of electricity - 1935 and 1959: total electric utility industry 1/

Items	1935	1959
Average number of farm consumers (thousands):		
On farms east of 100th meridian	551	3,516
On farms west of 100th meridian	213	1,056
Total	764	4,572
Energy sales (KWH in millions):		
On farms east of 100th meridian	482	17,141
On farms west of 100th meridian	1,211	9,812
Total	1,693	26,953
Average annual KWH sales per farm:		
On farms east of 100th meridian	873	4,875
On farms west of 100th meridian	5,673	9,292
Total	2,216	5,895

Source: Edison Electric Institute, Electric Utility Industry Statistics in the U. S., 1959, table 60.

1/ Farms east of 100th meridian are described as those where little or no irrigation is involved. Farms west of 100th meridian include farms in the west south central States where there is a considerable amount of irrigation pumping involved. Farm statistics are related to U. S. Census statistics and definitions available at time of preparation of tables.

The foregoing table indicates that the average number of farms using electric service in 1959 was 6 times the number in 1935; 1959 total farm consumption of electric energy was 16 times as great as in 1935; and average annual consumption per farm in 1959 was 2 2/3 times the 1935 consumption.

It is noteworthy that about 330 REA borrowers, one-third of the total, are serving over 40,000 pumping installations, irrigating an estimated 4 million acres, and utilizing approximately 750 million KWH annually. According to available estimates, the increase by 1980 in number of acres potentially irrigable will range between 1.3 and 7.4 million. No estimates are available showing a breakdown for electrically energized pump irrigation. In those areas where electric service is supplied by REA-financed systems, under existing loan policies and procedures, there is every reason to anticipate that future demands for electric energy for pump irrigation will be adequately and promptly met.

Effect of Electrification Upon Rural Nonfarm Development

The Rural Electrification Act authorizes loans to finance electric service to nonfarm as well as farm establishments in rural areas. Rural areas are defined by the Act as those not included within the boundaries of any city, village, or borough having a population in excess of 1,500 inhabitants.

At present it is estimated that over half the rural establishments served by REA-financed systems are nonfarm, and that new nonfarm consumers being added far outnumber new farm consumers.

There has occurred in recent years a fairly substantial shift of agricultural acreage to nonfarm use. This is a feature of the trend in the past decade, and continuing, toward the United States becoming an increasingly metropolitan and urban nation. In 1960 it is estimated 9/ that over 111 million people, more than three-fifths of the national population, were living in metropolitan areas, and that additional millions reside in urban developments that have not yet reached metropolitan status.

In the period between 1948 and 1960, a total of 5,228.9 square miles, or 3.3 million acres, of rural land was annexed to cities containing at least 5,000 people.10/ The extent to which this land was being employed in agriculture is not indicated.

Electric service has been made generally available in rural areas in the past quarter century either directly by REA financing or indirectly under the stimulus of the REA program. This has been an important factor in the shift of agricultural acreage to nonfarm residential, commercial, and industrial use.

9/Bollens, Metropolitan and Fringe Area Developments in 1960, pub. in 1961 Municipal Yearbook, p. 47. The 1960 Census shows total urban population of 125.3 million, or 69.9 percent of the total.

10/Bollens, ibid., p. 57.

1980 Requirements

Central station electric service is now available to virtually all farm operators who desire the service. Whether electric energy will be available in 1980 in the quantities needed, at the locations where needed, and at economical cost depends on the performance of the entire electric utility industry. Estimates of energy required to meet projected 1980 demands made for the Senate Select Committee on National Water Resources show increases as follow:

Type of demand	FPC 1/	EEI 2/	REA 3/
Farm, excluding irrigation and drainage	104	---	---
Irrigation and drainage	135	---	---
Nonfarm residential	253	---	---
Total, domestic (residential & rural)	227	400	---
Commercial	203	---	---
Industrial	207	---	---
Total, commercial and industrial	206	259	---
Other	185	92	---
Total	209	293	528

1/ Committee Print No. 10, table 3, page 4; shows projected increase in national requirements from 1958 to 1980; 1980 population estimated at 272.6 million.

2/ Committee Print No. 10, table 1, page 17; shows projected increase in national requirements from 1959 to 1980; 1980 population estimated at 245 million.

3/ Committee Print No. 10, table 1, page 61; shows projected increase from 1958 to 1980 in energy requirements of REA borrowers only. The REA estimates were not broken down as to consumer classification. However, in the period from 1956 to 1960, 9 out of 10 consumers on REA-financed systems were residential (farm and nonfarm) and they accounted for 70 percent of energy sales (1960 Annual Statistical Report, REA, Table VII, page X). In contrast, in the period from 1956 to 1959, although almost 9 out of 10 consumers served by class A and B utilities were residential, domestic or rural they accounted for only 29 percent of energy sales to ultimate consumers. (FPC, Statistics of Electric Utilities in the Unitied States, 1959, Table 19, page XXX.)

It should be noted that the percentile increase projected by REA relates only to energy requirements of REA-financed systems while the other projections relate to total national energy requirements. The increase projected by REA is substantially greater than the total increases projected by FPC and EEI, and the FPC and EEI projections for total domestic load which represents the bulk of the REA system energy requirements. The anticipated substantial increase in utilization of electrical energy for farmsteads and other rural establishments served by REA-financed systems and the fact that the bulk of REA borrower energy requirements is purchased from other suppliers point up the importance of an assured adequate and economical source of rural power supply for these systems.

In the event of substantial acceleration in electro-agricultural technology, the ability of the REA-financed systems serving a large segment of the Nation's establishments to meet the increased power and energy demands occasioned thereby could be an important factor in determining the extent to which these new technologies are applied to improve farm production and land and water utilization.

Another factor is the increasing number of farm and rural establishments served by REA-financed systems which are being vacated by owners and tenants and left idle. These are estimated to total approximately four-tenths of a million at present. An effective rural area development program could, by slowing or even stopping the movement away from economically marginal rural areas and by encouraging industrial and commercial enterprise in these areas, substantially contribute to the total growth rate of the REA-financed systems. The availability of modern, low-cost electric service is an indispensable ingredient not only in the operation of the efficient family commercial farm but in the transition of marginal farming areas from an agricultural to a commercial-industrial-based economy.

It is not anticipated that the increased demands for electric power and energy faced by REA-financed systems will require appreciable amounts of land and water for power generation and transmission facilities.

RURAL AREAS DEVELOPMENT PROGRAM

Under the Rural Areas Development Program, committees of local leaders representing all segments of community life--agricultural, business, religious, educational, civic, and other groups--are being organized in rural areas to formulate comprehensive programs for the economic development of their areas and to promote specific projects to implement such programs. These programs will be directed toward the overall economic development of the areas to which they pertain and not merely toward their development from an agricultural standpoint, and they will be of particular significance in obtaining better use of the Nation's soil and water resources.

For example, the adequate development of water resources must be related not only to changes in land use for agricultural purposes, but also to the needs of small towns and cities for adequate supplies of water. Likewise, the development of water resources must be closely related to recreational development and the need for water by new industries being established in rural areas.

Thousands of rural communities do not have adequate water supplies or adequate sewage disposal facilities. Both are needed as employment opportunities are developed. Almost one-fourth of the people of the Nation face a water shortage or have poor water, or both. By 1980, it is estimated that there will be a need for twice as much water as is currently used.

Rural Areas Development Committees are seeking ways in which to develop and more effectively use the natural resources of their areas. They are interested in promoting the development of watershed protection and flood prevention projects, the multiple use of forest and water resources, the improved management of privately held forest lands, and the greater application of research data to the problems of soil and water use.

In some areas, farms are too small. On some farms, men are attempting to grow crops for which the land is not suited. In many instances use of the land for forestry would be more productive. As new markets for farm products are created and off-farm employment opportunities are developed which can be used in conjunction with farming operations, land-use patterns will be affected. It is estimated that the family farm redevelopment phase of the Rural Areas Development Program will:

1. Over the next 15 years, provide assistance in reorganizing and developing 400,000 inadequate farms into adequate family farms, and

2. Provide needed services for 650,000 rehabilitated-in-place and retirement units for operators who, because of age, or physical, or other handicaps, are unable to shift to more promising farm or nonfarm occupations.

Changes in the use of land from one crop to another or the withdrawal of land from production as a result of acreage allotments and marketing quotas frequently make it difficult to develop and obtain compliance with an effective land and water resource policy. Such changes may create not only new production problems but also serious land-use problems which are aggravated by the underemployment which frequently results.

Obtaining a proper balance between the use of land for the production of agricultural commodities and nonfarm employment opportunities is a matter which deserves major consideration. The Rural Areas Development Program can serve as an effective instrument in achieving this desired balance. In addition, it can be the medium through which rural areas can obtain the benefits of other programs which will contribute to better soil and water use, such as those pertaining to credit, soil and water conservation, watershed protection, forestry, and research.

THE PLANT PEST CONTROL PROGRAMS

Annual and periodic losses caused by crop pests have a direct bearing on the present and future land-use policy of this country. Insects, diseases, nematodes, and weeds take an annual toll of $11 billion from our production capacity. Their control or elimination is an important factor in our capability of producing food, feed, fiber, and timber products for the continually increasing population.

Pest control contributes to stable agriculture and forestry. It eliminates the waste of low yields on highly productive soils. Losses occur after land has been committed and the principal cost of production incurred. Without control, more acres are required to provide plant products needed by the Nation.

The plant pest control programs of ARS are concerned with: (a) Incipient infestations of newly introduced pests; (b) introduced pests that have become somewhat widely dispersed but which may now be confined or eliminated with modern techniques and low-cost chemicals; and (c) insects native to this country, such as the grasshopper, which outbreaks periodically to cause serious damage.

There are 22 major programs involving insects, diseases, and nematodes, most of which have been introduced from foreign lands and have not reached the limit of their spread in this country, based on their ecological requirements. This is a select group of major crop pests that are a serious hazard to American agriculture and forest production. Need for their control goes beyond the capability and interest of the individual growers.

Prevention of further spread is the number one objective of most of the Division programs. Only one-third of the cotton production of this country has been exposed to the pink bollworm, a pest that in a single year destroyed the cotton production on the equivalent of 150,000 acres in one State. The golden nematode, which is capable of causing complete destruction of potatoes under heavy infestation conditions, has been confined to Long Island, N. Y., where only 3 percent of the Nation's potatoes are grown. The witchweed, which has laid fields in waste in the affected counties of the Carolinas, exists in an area where only 3 percent of the Nation's total corn, sorghum, and sugarcane crops are grown. The grasshopper, which outbreaks periodically and is capable of stripping range grass to the level of the soil and of completely destroying cultivated crops, is kept within bounds through annual treatment of relatively small outbreak areas. The Mormon cricket, which in the past has destroyed all crops in the wake of its migration, is not permitted to build up and form bands through the annual treatment of the nymphs in their hatching beds. Areas denuded by grasshoppers and Mormon crickets are subject to erosion and invasion by undesirable

weeds. If allowed to go unabated, these and other pests would cause an annual reduction in yields with a consequent increase in unit production costs and a drastic reduction in total crop production.

The control and containment of the pests which are included in the Federal-State cooperative programs contribute materially to the effective use of land resources. Pest control makes more cropland and rangeland available for new uses, improves pasture and range, and increases per-acre yields of susceptible host crops. Further reduction of losses caused by these plant pests could well be one of the means of providing the additional acreage that this country will need in the future for crop production.

THE CROPS RESEARCH PROGRAM

Cropland

Acreages of Major Crops

Technological advances have permitted acreage expansion in many crops. Twenty years of research permitted expansion of the soybean belt more than 100 miles northward through development of varieties adapted to the long summer days, and established soybeans as a major crop in the South through development of high-oil varieties. Forty years of research on the development of winter-hardy oats has permitted expansion of the former zone of production in the Southeast more than 100 miles to the north and northwest. Twenty-five years of research on development of winter-hardy, disease-resistant alfalfas and on seed production methods, has permitted doubling of acreage in the North Central and Northeast regions. The potential impact of technological advances on acreages of certain crops is projected in the following statements.

Cereal crops.- Research on cereal crops has the potential of an important impact on acreages in two major respects: (1) Extension of the present geographical area of adaptation and successful production. Research on genetics and breeding may give us rice varieties that will tolerate higher levels of soil and water salinity than those presently grown. The genetic potential in grain sorghums will permit breeding earlier varieties that would extend this crop into more northern regions where present varieties will not mature, and varieties resistant to insects and diseases will permit extension into the more humid eastern and southeastern regions. Breeding of more winter-hardy oat and barley varieties will permit material northward extension of the present zones of adaptation of winter forms of these crops. (2) Continued progress in breeding high-yielding hazard-resistant varieties will further reduce the acreages required for present levels of production.

Cotton.- The acreages of cotton production, disregarding control programs, have been reduced in the southern and southeastern part of the U.S. by the severity of insect problems (primarily cotton boll weevil), adverse climatic conditions, and poor adaptability of much of the area to mechanized agriculture. With the inception of the Boll Weevil Laboratory in Mississippi this year and a comprehensive attack on the basic needs of research to develop controls through fundamental research in all pertinent disciplines, it is anticipated that the boll weevil problem will be greatly reduced in the coming years. When this occurs, with the ultimate development of mechanization, soil and water management, cultural practices, and supplementary irrigation, it is expected that sizable acreages in this region may return to cotton production.

The limiting factor in cotton acreage in the western irrigated States is water availability. There are at least 1 million acres of virgin desert valley land in Arizona and California that could be developed for cotton production with an adequate water supply. Assuming that adequate water supplies will be available, and should future needs indicate expansion, cotton could be adapted to other areas now considered to be outside the Cotton Belt because of inadequate growing seasons. Cold tolerance studies and plant breeding efforts to develop rapid-maturing varieties indicate that there is a distinct possibility of pushing growing season requirements down to permit the migration of cotton to more northern limits.

Citrus.- The advent of fresh frozen concentrated orange juice has created a tremendous increase in the demand for citrus and there is currently an insufficient supply of fruit for concentrates. With increasing popularity of concentrates and increased population it is anticipated that a large increase in orange production will be needed. Some increases can be expected from greater production per acre on the present acreage, but most of the needed increase will have to come from new acreage planted with new varieties and rootstocks developed for use on land not suitable for those presently available.

Pears.- Disease, particularly fire blight, limits pear production in eastern United States. Recent development of the resistant varieties Magness and Moonglow, could result in sizable expansion in pear production in eastern United States. Pear decline, a new devastating disorder which kills pears on Oriental rootstocks, is spreading rapidly in western pear-producing areas, and will reduce pear production in the Nation by 50 percent or more. The supply of quality pears is already so low that they are considered a luxury fruit.

Sweet cherry.- Production of sweet cherries is largely limited to the Pacific Coast areas. New and firmer-fruited varieties less subject to rain cracking could improve the market quality of sweet cherries in eastern markets and hence expand the demand and correspondingly increase the acreage of this luxury fruit that could be grown in the humid region.

Blueberries.- Blueberries are in sharp demand both for fresh fruit and for processing. The new varieties provide excellent material to expand the industry by at least 10,000 acres. Blueberries grow on marshland not suitable for other fruit crops or for most other agricultural crops.

Brambles.- Bramble fruits are in extremely short supply due to the hazards of disease. Research, to develop virus-free clones of raspberries and more cold-hardy thornless blackberries, is underway

and should provide material for reestablishment of a raspberry and blackberry industry in eastern United States which will require up to 10,000 acres.

Tung.- The present commercial production on approximately 180,000 acres is equal to about 50 percent of the tung oil used in the U.S. Tung production is limited by lack of late-blooming varieties that escape spring frosts. A breeding program is underway to produce a spring frost-hardy variety. With such a variety, tung production could feasibly be doubled. Tung is grown in a belt of the Deep South on land generally not suited for other farm crops.

Pistachio nuts.- The pistachio nut is a new crop for the United States. Some 20 million pounds are now imported from southwestern Asia. The crop does well under irrigation in California, but yields are uneconomically low for this high-priced land. It is under test for west central Texas where the climate is similar to growing areas of Asia. With acceptable results, west Texas could easily utilize 75,000 acres of land not now under cultivation and not suitable for other crops.

Drought-resistant range legumes.- At least 200 million acres of native grassland and abandoned farmland in the western States need adapted legumes for conservation management and economic return. While grasses on much of the dry rangeland respond to nitrogen fertilizer, such fertilization is not economical. The potential contribution of nitrogen fixed through nodulation of adapted legumes is promising. Such legumes can be expected to increase forage yield, improve quality of the forage, and stabilize production. Rhizomatous and creeping-rooted types of alfalfa are especially promising.

Soybeans.- Varieties of soybeans will be developed with resistance to nematodes and diseases and adapted to short photoperiod conditions, that will increase the acreage planted to soybeans in Florida and the Gulf Coast States. There is reasonable expectation that early-maturing varieties for the North Central States may increase crop production per acre by causing farmers to double-crop soybeans and winter wheat. Soybean acreage will not increase materially, but total crop production will increase.

Flax.- Research in flax is expected to increase efficiency of production through varieties with higher yield of seed, greater resistance to disease, higher oil content of the seed, and improved quality of the oil. Research now underway in plant physiology and mineral nutrition is expected to point the way to improved fertilizer response in flax that will permit the plant to make greater use of available water. No important acreage change is anticipated as a result of production or breeding research.

Castorbeans.- Research on castorbeans is aimed largely toward control of diseases, development of higher yield through F_1 hybrids, and increased oil content of the seed. Alternaria leaf spot, root rot, capsule mold, and capsule drop are limiting factors of production in some areas. Breeding work indicates that much progress can be made in the near future in developing greatly improved inbred and hybrid varieties. Acreages may expand several-fold as the result of the development and release of these varieties.

Safflower.- There has been a steady increase in acreage of safflower as a result of research. Yield, disease resistance, and oil percentage have been increased to a point where safflower can compete with other crops grown west of the 100th meridian. Further research will provide improved varieties with thinner hull and consequently higher oil content and with greater resistance to root rot, rust, and other diseases. Acreage is expected to expand. Research on the nutritional value of safflower oil, with reference to the importance of poly-unsaturated oils in the human diet, may create an increased demand for safflower oil for edible purposes.

Sesame.- The acreage of sesame is limited sharply by the dehiscent nature of the varieties now available for commercial production. Current research on sesame gives high priority to developing varieties suitable for complete mechanization, that are easily threshed, have high yield of seed of good quality, and have resistance to root rot, leaf spot, and other diseases. With expected advances in these areas of research, the acreage could increase several-fold.

Sugar crops.- Slightly more than half of U.S. sugar requirements are met by domestic producers under the quota allotments by the Sugar Act. Approximately 40 percent of our domestic production is from sugar beets grown on about 1.0 million acres and the remainder from sugarcane grown on about 0.9 million acres of the Mainland, Hawaii, Puerto Rico, and Virgin Islands. Our gradual increases in sugar requirements are about in line with growth of population, or roughly an increase of 2 percent per year. A sustained increase in yield of sugar per acre through application of new research findings on sugar crops has been about equal to the annual 2-percent increase in requirements, and assuming there is no modification of the Sugar Act, the future quota of domestic sugar can be produced for a good many years ahead on approximately the present stabilized acreage.

Tobacco.- In recent years there has been deterioration in tobacco quality due to the emphasis which has been placed on high yields, greatly stimulated by acreage control programs. Greater yields per acre could be obtained by using even higher-yielding varieties combined with cultural practices such as increasing the

use of fertilizers, by prevention of sucker growth through use of chemicals, by greater use of irrigation, and by more effective control of plant diseases, but generally at considerable reduction in quality. With continued improvement, such as crop rotation practices, better disease-resistant varieties, and disease control with chemicals, the trend would be toward a decrease in the acreage in tobacco production, with certain other influences in the opposite direction. Labor requirements for tobacco production average about 400 man-hours to raise 1 acre compared to an average of about 8 hours to raise an acre of wheat. More effort will be made to mechanize the crop, resulting in an estimated 10 percent reduction in acre-yields due to inefficiency of machine operations. This could result in some increase in acreage requirements. Taking all factors into consideration, no significant change in tobacco acreage would be expected in the near future.

Vegetable crops.- So little cropland is adapted to vegetable crops that any step-up in intensification and centralization must of necessity, be limited essentially to present production areas. These areas represent slightly more than 1 percent of total farmland devoted to crops. With land areas adapted to these crops so critically limited, it is of utmost importance in long-range land-use planning that vegetable crop areas be reserved permanently for agricultural use and that efforts be made to prohibit the dangerous conversion to nonagricultural uses of the limited areas specifically adapted to these crops. With improved varieties, new breeding methods, new methods of disease control, and improved cultural practices made possible by research, there is a trend toward intensification and concentration of the areas currently devoted to these enterprises. This trend is coupled with higher total production.

The development of new vegetable varieties--including potatoes that are heat tolerant, yam-type sweet potatoes adapted to northern conditions, slow-bolting lettuce types, onion hybrids with changed day-length requirements--will help in overcoming certain climatic limitations and permit vegetable production areas to expand slightly into new regions. On the other hand, the development of vegetables with disease resistance to soil-borne pathogens (along with microbiological control) will enable some of the older areas to "come back" into efficient commercial production.

Ornamental crops.- With improved cultural methods and growth-regulating research, the production of ornamentals is moving from northern greenhouse production to southern field production. Acreages of cut flowers and pot flowers grown in adapted areas of the South have increased markedly in the last five years and, by 1980, should represent an entirely new industry for much of the South.

Development of New Cropland

Phreatophyte replacement will save water on an estimated 16 million acres in the arid West. The logical replacement vegetation for such areas is forage. The addition to the acreage of grazing or forage-producing land will partially offset the decline in grazing land in the U.S. of about 120 million acres since 1910. At present, the western range is supporting more livestock than it did 30 years ago, and at the same time range conditions have improved. It is highly desirable that the western range be improved much more but this probably will not be possible if livestock numbers continue to increase and the area available for grazing continues to decrease.

Much brush-infested land can be converted to pine timber production by efficient control or removal of undesirable woody species. Such land could also be converted to grass production for grazing purposes.

Improved weed control methods will permit the development of new cropland. For example, large acreages in Arkansas and Texas could be used for rice production, provided certain troublesome weeds could be controlled.

More effective control of perennial weeds in marshes and bogs can be expected to permit cranberry and blueberry growth in many new areas. It is estimated that there are 125 million acres of wetland in the U. S., and much of it could be used for some type of crop production through effective and economical weed control.

The use of herbicides is permitting the development of new production practices. For example, legumes can now be grown interplanted with corn. Formerly, the corn had to be cultivated and no legume crops could be grown between the rows.

New land areas for vegetables, including potatoes, are being developed at high costs per acre by drainage of peat-marsh areas. Development of such land is costly but essential. Land along the eastern seaboard and the Gulf of Mexico is best suited for vegetable production by reason of nearness to population centers and availability of adequate water supplies for irrigation. Where water for irrigation is not limiting, dryland areas of the Northwest are particularly adapted because of highly favorable climatic conditions.

Improving of Existing Cropland

Legume and grass crops are essential tools in soil conservation and improvement. Research progress, anticipated in development of hybrids and improved varieties with multiple disease and insect resistance and adapted for use as hay and pasture, will permit shifts

of certain croplands to grassland use on a rotation basis. This should conserve and enhance the yield potential of many soils.

Irrigated pastures in the arid West, when managed by procedures now understood, will significantly increase the fertility and water-holding capacity and hence the productivity of the West's 30 million acres of irrigated land. For maximum yield and benefits to the land, pastures need not remain longer than five years.

Significant increases in carrying capacity of improved pastures by the use of irrigation in the humid region can also be realized. Under proper management, irrigated pastures on good land are capable of increasing the carrying capacity as much as 35 percent so that the shift has good economic potential. Systematic rotation of well-managed pasture on all land will provide means for a permanent and soil-improving agriculture.

Pasture and Range

Forage feeds derived from soil-building and soil-conserving grasses and legumes never have been a burdensome surplus. At least 125 different species of grasses and legumes can be used in different regions of the United States. These species offer great opportunity for better hay, pasture, range, green manure, and cover crops, and also for soil conservation, watershed protection, and for other uses. Genetic improvement of cereal crops for cultivated pastures for winter use has great potential. Research will contribute to more stable feed supplies and reduce hazardous fluctuations in the annual production of livestock and livestock byproducts.

Land-use developments for urban, industrial, and highway developments, and high priority for better lands for food and fiber crops, are making serious inroads on grasslands. Despite this slowly declining acreage of grassland, total forage production must be increased 30 to 35 percent by 1975 to meet the feed requirements of animal numbers projected for that time. To accomplish this will require some significant breakthroughs in forage breeding and management research. Otherwise, some attention may have to be given to expanding acres of grassland.

Forage production on pasture and rangelands can be expected to improve through the development of improved methods for the control of brush and perennial weeds by chemicals and other means. For example, the frequent losses of stand in the establishment of forage pastures due to weeds can be reduced and the quantity and quality of forages in pastures and ranges can be improved through selective weed control. Eighty percent of the pastures are not

tilled and the use of chemicals provides one of the best approaches for the control of weeds. This practice is frequently referred to as chemical renovation of pastures.

The use of chemicals will provide a way for the control of poisonous weeds such as halogeton and tall larkspur, which cause heavy loss in livestock production. The quality of wool, milk, and meat can be improved by the control of weeds such as cocklebur, wild garlic, and bitterweed, respectively.

Growth regulators have been shown to improve the palatability of certain forages and the development of their use can be expected to improve hays and pastures.

Nematology research will contribute to the improvement of pasture and range crops through the introduction of nematode-resistant varieties and by avoidance of crop combinations or successions most favorable to nematode attack.

Sizable land areas in the United States are unproductive or otherwise unsuited for crop production. Included in these are: (1) Wet lands; (2) abandoned lands formerly cultivated, due largely to erosion; (3) saline soils in irrigated regions; and (4) strip mine areas. Accurate figures on acreages of these lands are not available. It has been estimated that there are 67 million acres in need of drainage. Vast acreages in the southeastern States as well as in other areas are no longer cropped, due largely to severe erosion and to infertile soils. Many of these acres have become wooded, others are in unproductive and unimproved pastures of limited use. The salt content of one-fourth of the irrigated land area of the West is too high for maximum crop production. In many States, where coal and other minerals are strip mined, relatively large acreages of formerly good soils are covered with the overburden resulting from the mining operation. The reclamation of the lands for crop production is a slow process because of a lack of adapted legumes and grasses for such conditions. Droughty soils in the form of deep sands in ridges and other landforms, are low in organic matter and mineral elements. Covers of adapted legumes and grasses developed through research could improve the agricultural value of such soils. While improved drainage, improved methods of reducing salinity, and the proper use of soil amendments and fertilizers will contribute materially to the process of reclaiming these lands, the ultimate sucess of this program is dependent on the development and use of productive soil-improving legumes and grasses. Significant contributions are anticipated, as indicated in the following.

Wetlands

The development of productive new varieties of birdsfoot trefoil that carry resistance to crown and root rot and that can be established with ease is well underway. White and zigzag clovers could be improved for development of productive, persistent varieties well-suited to such land areas. As drainage is improved, some of the new varieties of alfalfa can be used. These legumes could be used alone and in association with improved varieties of grasses such as Reed canary, meadow, foxtail, and tall fescue for pasture and hay.

Abandoned Lands

On these lands in the Southern States, vigorous growing, long-lived, productive legumes could be developed to grow in association with productive grasses to reclaim abandoned lands, to control erosion, and to provide some pasture, hay, or silage while improving the soil. Some progress has been made in breeding sericea lespedeza for productive, palatable (low tannin), root-knot-resistant varieties.

In the Central and Northern States, improved varieties of red clover, rhizobium-compatible strains of Kura clover, and birdsfoot trefoil in association with grasses, will be important in bringing these lands back into production. Crown vetch has real potential on the well-drained, less fertile soils.

Saline Soils

Studies have shown that trefoil, strawberry clover, sweet clover, wheatgrasses, Rhodesgrass, and others excel in tolerance to soils containing relatively high amounts of salt. It is reasonable to assume that within these species more productive, salt-tolerant lines could be developed to meet present and future needs.

Reclamation of Strip-mined Lands

The overburden from strip-mined lands is a conglomeration of soils and minerals weathered to varying degrees. In certain areas, crown vetch is contributing significantly to the reclamation of these soils. Kura clover also offers a potential for such problem areas. The development of more nutritious and productive varieties having strong seeding vigor will give these crops utility for reclaiming waste lands, conserving soils, and providing livestock feed.

Range Improvement Research

Range improvement research can provide the basis for increasing and stabilizing the production from our grazing lands having favorable soil and climatic conditions. Diversion of croplands to improved pastures, to supplement native pastures and ranges, offers the best opportunities for production potential. The development of grass-legume mixtures for specific conditions and use, and effective grazing and management systems, will provide more efficient and consistent production. Arid grazing lands are limited by water and, at present, millions of acres are infested with brush and undesirable forbs that compete for moisture. Range improvement can be accomplished by control of this competing vegetation. Range improvement practices on the more difficult sites, however, may no more than offset the diminishing land area available for forage production.

Water Use

Varietal improvement can lead to greatly increased efficiency of water use. Morphological and anatomical characteristics influence transpiration and evaporation from soil. Disease-free plants use water much more efficiently than diseased ones. Varieties with high yield potential use water more efficiently, and those varieties such as short-strawed semi-dwarf wheat, barley, and oats, tolerate and respond to heavy fertilization which, in turn, promotes water use efficiency. Plant type, nature of leaf surface, and root systems have a major effect on transpiration. All of these factors are subject to genetic control and modification. Crops such as sorghum tolerate drought periods and then recover to utilize irrigation water or rainfall available later.

Improved weed control measures permit minimum tillage, which conserves moisture and results in improvement in soil structure. Such improvements in fallow programs can also be expected to aid in nematode and plant disease control.

The development of more effective aquatic weed control measures will result in increased water flow in irrigation and drainage canals and in decreased waste of water from immersed and phreatophytic types of vegetation.

The rate of water use by crops is a function of both the plants and the climate. Efficiency of water use by forage plants can be affected by plant breeding and management research. There are several avenues of approach, some of which are: Breeding perennial varieties of grasses that produce maximum growth in the spring and become dormant in the summer will minimize transpiration loss of water; full use of sunlight may lead to increased

forage yields with resultant improvement in efficiency of water use; development of legume varieties having anatomical characteristics, such as fewer stomata and thickened leaf cuticle, and may be of importance in production and persistence; and waterspreading practices on the many grazing-land watersheds will increase their productivity and the efficiency of water use.

Farm Windbreaks

In the Great Plains, plantings of trees and woody plants have been made over a period of a century to conserve soil and water resources. Properly planted windbreaks are increasingly important in providing an even distribution and accumulation of winter snows and reducing wind erosion of soil. Recent research has shown that proper plantings are of great value to reduce wind velocities, to conserve natural resources, and to create conditions favorable for soil and water conservation.

Crop Yields

Projections of yields per acre in 1975 for major crops, taking into account the anticipated impact of technological advances, have recently been made by plant scientists and agricultural economists. The crops for which predictions were made were the feed grains--corn, oats, barley, and grain sorghum; the oil crops--soybeans, peanuts, and flax; the food grains--wheat, rice, and rye; other food crops--potatoes, dry beans, and sweet potatoes; tobacco; cotton; and the forages--hay and pastures. The predicted rates of increase for 1975 were projected for 1980 and 2000 in a study made for the Select Committee on National Water Resources, U.S. Senate, in a report entitled, Land and Water Potentials and Future Requirements for Water, Committee Print No. 12, 1960. The crop yields projected for 1980 and 2000 average 42 and 75 percent greater, respectively, than yields in 1954. Considerable variation in rate of increase exists among crops. The projections assume rates of research accomplishment and rates of adoption of technology by farmers commensurate with those of the past several decades.

Improved Practices

Cereals can be bred to resist lodging and to utilize fertilizers at much higher rate than current varieties (example, semi-dwarf wheat in the Pacific Northwest). Application of genetics to crop modification in connection with use of other agricultural chemicals (herbicides, fungicides, insecticides) to increase the margin of

safety or to make chemicals more selective through resistance of crop plants to them, has great potential. Some of the factors mentioned above--such as hybrid wheat, barley,and oats; disease and insect resistance; and numerous other ways in which the crop may be modified by breeding--may be very important. New types for new uses, such as high amylose corn, could alter the demand picture.

As new and better weed control chemicals and techniques are developed, there should be fewer crop failures. The ratio of crop acreage planted to acreage harvested should rise considerably over present levels. The use of pre-harvest chemicals, and other growth controlling techniques, can lead to improvements in quality and increased crop yields, as has already been demonstrated in cotton for harvestable yield and fiber quality. Similar potentials exist for many other field and horticultural crops.

Suitable land is rapidly becoming a limiting factor to further increases in citrus production. Most of the land suitable to citrus production has now been planted. New plantings will have to make use of flat lands, reclaimed through drainage, or areas farther north and more subject to cold. Development of rootstocks suitable for flat lands and rootstocks and top varieties which are more cold-hardy are in progress.

New Crops

Oilseed Crops for Industrial Uses

The ARS new-crops screening program has discovered more than a dozen new oilseeds which have high utilization potential and which could be grown in this country. In aggregate, these new crops could be profitably grown on 5 to 6 million acres. Among these are plants adapted to the Cotton Belt, the Corn Belt, and the small grains areas of the more arid West. So far, due to limited resources, only one of these prospects has been taken up for crop developmental studies. The others must, of necessity, remain as of only academic interest until resources are available for their development.

New Seed Mucilage Crops for Industrial and Food Uses

Guar, introduced from India and grown in our Southwest, is our only domestic source of nonstarch carbohydrate mucilage of the useful galacto-mannan type. We produce no more than 10 percent of our needs for this commodity. Guar is a highly drought-resistant annual legume and an excellent soil improver. It is adapted to areas where summer dry periods coincide with the seed maturation period. Expansion of guar production and the development of promising new seed mucilage crops, adapted to our more humid Southeast, could profitably utilize more than 1 million acres.

New Annual Crops for Paper and Dissolving Pulps

Our forest resources are supplying, and probably could continue to supply for many years, our raw material needs for a rapidly expanding pulp industry. Use-patterns of forest resources are changing and there are increasing pressures for more watershed protection and recreational areas. The physical and chemical properties of wood pulps limit the uses which can be made of them. There is an increasing need for pulps having properties different from those of wood pulps and which can satisfy specialty uses or be used in blends with wood pulps. The ARS new-crops screening program has found new plants having desirable fiber characteristics and high yield per acre potential as annually harvested pulp crops. By the year 2000, with emphasis on development of these crops, our Corn and Cotton Belts could be producing 4 to 6 million acres of new pulp crops.

Sunflower

In the USSR, the sunflower has been developed into a highly successful oilseed crop. Because of its lower water requirements, sunflower has largely replaced soybeans in the Soviet Union except in the eastern area bordering Manchuria. In the United States, sunflower, though native to this country, is grown only to a very limited extent as an ensilage crop and for bird seed. Sunflower-seed oil is another edible oil which would be competitive with our present vegetable oils such as soybean, corn, peanut, and so forth. However, sunflower could be produced on dryland wheat areas of the Pacific Northwest, providing a needed protein feed supplement for the livestock industry of that area, and releasing soybean acres in the Corn Belt for new pulp crops, new seed mucilage crops, and new industrial oil crops. On a long-time basis, with emphasis on developing this crop, the use of several million acres might be profitably shifted in this manner.

THE SOIL AND WATER CONSERVATION RESEARCH PROGRAM

In a normal year, the United States averages 30 inches of precipitation. About 21 inches are used in evapotranspiration. The remainder, 9 inches, is returned to streams. About two-thirds of the streamflow occurs during flood periods and less than one-third is available over the majority of the year. By storage and regulation of release, it is thought possible to provide a future constant availability of about 5 inches of the total precipitation. Half of this is required for navigation and waste disposal, leaving about 2.5 inches for irrigation, industrial, and domestic uses. Presently we are using about 0.9 inch for all of these, of which about 0.4 inch goes for irrigation. While average figures such as these are not too meaningful, they do illustrate that definite limitations exist on the amounts of water available for irrigation.

Not all water is suitable for irrigation. Brackish waters along the tidal inlets of the seacoasts, some western rivers, and many wells may contain soluble salts in excess of that safe to apply on the land.

Pollutants from industries, nuclear reactors, drainage ditches, and sewage may also render streams unsuitable for irrigation, particularly during periods of low flow. Ground water supplies may be polluted also.

Probably less than 15 percent of the potential croplands of the United States are suitable for irrigation. Soils in arid regions having a combination restricted drainage and high content of soluble salts and alkali are poor irrigation risks. Steep lands cannot be irrigated effectively, and extremely sandy soils retain too little water to justify irrigation except for certain high per-acre-return crops grown in areas of favorable climate. As a rule, only class I, II, or III lands are considered suitable for irrigation.

There are about 18 million acres of unirrigated land remaining in the 17 Western States and about 29 million acres in the East which conceivably could be irrigated if necessary (see table 6). Full expansion of irrigation, however, is likely to come slowly and only in response to population pressures because of high costs involved. By 1980, assuming a medium potential for irrigation, it has been estimated that an increase of about 4.7 million acres for the West and 2.5 million acres for the East would occur. By 2000, using the same assumptions, the increase would be 11.2 million acres for the West and 4.7 million acres for the East.

Table 6.- Potentials for increasing irrigation in the United States 1/

(Million acres)

Area	Irrigated in 1957	Estimated irrigated by 1980	Potential by 2000	Soils suitable for irrigation	Maximum irrigation potential 2/
Eastern States:	2.4	3.3	5.7	31.2	31.2
Western States:	32.0	32.4	37.9	62.0	50.4
Total------:	34.4	35.7	43.6	93.2	81.6

1/ Senate Select Committee on National Water Resources, Land and Water Potentials and Future Requirements for Water, Committee Print No. 12, 1960.

2/ Acreage for which soils are suitable and water is available.

Removal of excess water from croplands and prevention of overland flow markedly affect crop production potentials. About one-fifth of our present cropland either has been brought into production or has been greatly improved through drainage. Drainage also goes hand in hand with development of successful irrigation projects in the West. The full potential to be realized from drainage, however, has not been reached on existing croplands and many of the new croplands of the future will require extensive drainage.

Improvements in drainage of present croplands can be brought about largely through rehabilitation of existing drainage systems at comparatively low costs. Improved yield potentials and more efficient operation can be achieved through such things as combinations of surface and subsurface drainage systems, more effective spacing and depth placement of tiles or moles, improvement of outlets and lateral systems, drying out of potholes, adjustments of rates of water removal to crop and soil needs, improved maintenance and functioning of installed drains and drainage channels, adjustment of water tables to prevent subsidence on peat and muck soils, and removal of unneeded field ditches and soil banks. Also, greater efficiency would result from coordination of piecemeal drainage systems and incorporation of larger acreages into community drainage enterprises.

There seems to be little question that drainage will be a major factor in increasing our agricultural potential. Undoubtedly, drainage improvements on present croplands will be continued. In response to increasing population pressure, new or improved drainage systems will expand first into grasslands and gradually into the better forest lands.

Other wetlands, such as the inland and coastal marshes and swamps, which are also important wildlife habitats, will probably receive drainage only as a last resort. In western irrigation projects on new lands, however, drainage is a necessary complement to the successful application of water.

Real possibilities exist for reducing costs of drainage and for improving the design and effectiveness of drainage systems. Plastic-lined mole drains equipped with grade control devices are now under advanced stages of development and offer considerable promise for greatly reducing the cost of internal drainage. Improvements are being made in design of surface removal of water. Use of electrical resistance networks, combined with better understanding of soil properties as related to water movement into and through the soil, promise to take much of the guesswork out of designing drainage systems. Much research, however, still remains to be done.

Since water is a major limiting factor in crop production and there are definite limitations on the amount available to agriculture, the only alternative to moisture shortages is moisture conservation. Fortunately, there are tremendous possibilities for moisture conservation which fall into three main categories: (1) Conserving runoff water for irrigation; (2) getting more water into the soil moisture reservoir; and (3) obtaining more efficient utilization of the available moisture stored in the soil.

Water conservation for irrigation can be achieved through increased use of dams and regulated release, increasing underground storage by artificial means, reduction of conveyance losses through canal lining systems, control of phreatophytes, increased reuse or recycling of waste waters, improved management of watersheds to regulate water yield, reduction of pollutants, prevention of salt intrusion, reduction of siltation of reservoirs, and the like. Full exploitation of these measures can go far in increasing the water supplies available to agriculture, particularly in the Western States.

Replenishment of the soil moisture reservoir through encouraging water intake and reducing runoff offers more potential in subhumid and humid regions than does irrigation. Replenishment can be achieved mainly through adoption or improvement of known practices such as surface mulches, cropping systems designed to increase the intake rate, and contour cultivation to hold the water on the land longer.

Exciting possibilities exist for more efficient use of soil moisture. It has been variously demonstrated that 40 percent or more of the water used in crop production is evaporated from the soil surface, which is much higher than originally thought. Although evaporation can be suppressed in experiments by covering the soil surface with a thin layer of plastic, practical field measures present many problems. Since heat from the sun converts liquid water into vapor in the evaporation process, evaporation suppression becomes largely a matter of diverting the heat from the evaporation process. Possibilities for reducing surface evaporation thus rest primarily in providing more thorough shading of the soil surface by the growing plants and in arranging the row directions and the geometry of the plants so that there is a minimum of solar energy to be dissipated in evaporation at the soil surface. Evaporation suppression probably will be practical only on soils having a sufficiently high water holding capacity to store sizeable amounts of moisture. Also, sufficient precipitation is required to fill or nearly fill the soil reservoir. The Midwest would most closely meet these criteria.

Possibilities also may exist for reducing water losses from transpiration by spraying plants with wax-like chemicals. However, since evaporation is a major means of cooling the atmosphere around the growing plant, transpiration control would encourage heat buildup which in turn would increase respiration and tend to offset overall yield gains. On the other hand, dissipating heat through air turbulence brought about by controlling the arrangement of crop plants in the field, or by limiting this treatment to crops that make their major growth during the cooler portions of the growing season, might offer real promise.

Obvious discrepancies exist between the growth characteristics of certain plants and water efficiency. For example, the lower leaves of corn are parasitic. They transpire water without photosynthesis due to shading. Ideally, a crop should have a dense canopy with all leaves exposed to the sun, as is the case in tropical forests. Such a canopy would permit maximum active photosynthetic area and at the same time shade the soil against incoming solar energy. Plant breeding and cultural programs with such an objective might raise the yield potentials of certain crops tremendously.

Anything that increases the dry matter production of a crop increases its water efficiency. Fertilizers are particularly effective in this respect. In fact, the efficiency of water use may be doubled. Increasing plant populations, utilizing more of the growing season through early planting and later maturity, encouraging rapid initial growth, and substituting high yielding for low yielding crop varieties will all improve efficiency.

Fertilizers and lime play a very great role in the maintenance and improvement of the productive potential of agricultural lands. Before the advent of fertilizers and lime, our early agriculture was marked with abandonment of exhausted land. About 20 percent of the increase in farm output since 1940 has been attributed to fertilizers. We are now applying 7.4 million tons of primary plant nutrients, of which 2.6 million tons are nitrogen, 2.6 million tons are available phosphate, and 2.2 million tons are potash.

Considerable evidence indicates that we have not yet exploited the full potentials of fertilizers as a crop-producing-factor. Fertilizer use on most agricultural lands in the United States is modest in comparison with other progressive countries having highly developed or intensive agricultures. This is brought out in table 7. As pressures on our agricultural lands approach those of Western Europe, there is good reason to believe that fertilizer use on our better croplands where moisture is not a critical factor will also approximate that of Western Europe. However, on drylands and lands of lower productive potentials, fertilizer use will stabilize at lower levels.

While fertilizer use has increased greatly in the United States in recent years, the same does not apply for lime. Acid soils remain notoriously underlimed, and this situation must be corrected before we can realize full potentials of crop production.

Table 7.- Average rates of fertilizer application ($N+P_2O_5+K_2O$) per acre of agricultural land in 1957 for selected countries 1/

Country or region	Pounds per acre
Japan	190.0
Belgium	182.0
Netherlands	177.0
Formosa	129.0
Norway	126.0
West Germany	122.0
Denmark	107.0
United Kingdom	47.0
France	46.0
United States	12.5
Central America	6.5
South America	1.0
Africa	0.7

1/ Agricultural land includes arable, tree crops, permanent meadows, and pastures.

Source: Page, H. J., Trends in fertilizer consumption in relation to world food supply, Outlook of Agriculture 2(5): 203-212, 1959.

Current use of lime in the United States averages about 20 million tons annually. This level of lime consumption is sufficient only to offset lime depletions through leaching and crop removal. For example, assuming a 250-pound-per-acre annual loss from an estimated 170 million acres of harvested cropland in the humid regions, this would amount to about 21 million tons. In addition to normal losses, many farm soils have accumulated residual acidity as a result of inadequate liming in the past, and others, particularly those in permanent pasture, have never been limed. A 1950 U. S. Department of Agriculture survey of conservation needs indicated that annual use should approach 80 million tons, and that some 556 million tons would be required to reduce acidity to a level conducive to good crop production.

New lands and grasslands shifted to croplands will require large initial applications of fertilizer and lime. Soils of many of these lands, particularly in the East, are inherently very acid, and low in phosphorus and potassium.

Recovery of fertilizer nutrients by plants is alarmingly inefficient. Only about half of the nitrogen, 10 percent of the phosphorus, and half of the potassium applied is recovered by crops. Certainly more efficient ways will be found some day to provide crops with the nutrients they require. Marked improvements in the efficient use of fertilizers, however, do not seem to be forthcoming in the immediate future.

THE ENGINEERING RESEARCH AND DEVELOPMENT PROGRAM

First, it should be noted that much of the engineering research and technology directed toward agriculture is, and will continue to be, concerned primarily with reducing labor requirements and production costs. On the other hand, taken as a whole, engineering research and technology will have important effects on the land and water situation in 1980. However, these effects will be so interrelated with those resulting from the research activities of soil, plant, animal, and other biological scientists that it is very difficult to isolate and predict the extent of the probable influences of engineering technology.

Therefore, the following outline statement is suggestive and qualitative rather than quantitative.

New and improved equipment for land improvement will help increase the output of much of the land now in crops and increase the area of now unused land which it will be feasible to farm. Operations involved will include landforming, smoothing, grading, leveling, terracing, and removal of rocks, stones, brush, and trees. The technological possibilities are very great. The real question is economic: Will the developed land be worth the cost?

New developments in tillage equipment and methods will tend to counteract the detrimental effects on the soil of heavier field equipment and the more complete mechanization of all field operations. The net effects on land productivity will probably be small.

Improved precision planting and fertilizing equipment specifically adapted to given crops and given regions will tend to improve uniformity of stands and timeliness of planting for many crops and thus increase yields. Precision planting means uniform depth and straight rows, as well as spacing along the row. It could even include a specific orientation of seeds if there appeared to be value in such orientation as appears possible for corn.

New and improved equipment and methods for all phases of all types of pesticide applications, including helicopters for dusting and spraying, will help attain the yield potentials of improved crop varieties and cultural practices.

The effects of new developments in harvesting equipment will probably be widely varied. (1) The harvesting losses for grains, including corn, and for other field crops, such as beans, are too high. These losses may be reduced. (2) On the other hand, the mechanization of the harvest of many vegetable crops, and perhaps certain fruit crops, will probably involve a once-over machine operation, rather than several partial harvests by hand. This will tend to materially reduce yields. (3) If field shelling becomes the accepted practice for harvesting corn, the cobs will be lost unless special arrangements are made to collect them. (4) Improved equipment, structures, and methods for harvesting, handling, and storage of forage crops may materially increase the net contribution of forage acres toward meeting total land needs.

Improved equipment and methods for harvesting crop residues, straw, corn stalks, and so forth are a definite possibility of livestock feed and bedding needs, and other economic relationships should justify the costs. Such a development would tend to reduce land needs.

Improved equipment and methods for establishment, maintenance, and renovation of forage land could materially increase the productivity of many acres of meadow, pasture, and rangeland, particularly if combined with proper land fertilization and livestock management.

New and improved equipment for soil and water conservation farming practices would, over the longrun, help conserve soil and water and thus help meet soil and water needs.

Improved structures and equipment for livestock production, emphasizing all phases of environmental control, could materially increase feed efficiency, and thus tend to reduce the area of land needed for feed production.

New and improved equipment and techniques for the utilization of electric energy in agricultural electrification brought about by research, will result in improved land and water utilization by better protection of plants and animals from insects, increased utilization of radiation treatment on seed stocks dormancy, increased possibility of utilization of forages by mechanized preparation, handling, and feeding procedures, and mechanized handling and disposal of agricultural wastes such as manure.

THE ANIMAL DISEASE AND PARASITE RESEARCH PROGRAM

If by some miracle all the diseases and parasites were eradicated from our livestock and poultry, the immediate effect on our needs for land and water resources would be tremendous. The present level of production could probably be maintained by using about half the land now required. About 58 percent of the acreage under cultivation is used to produce livestock and poultry. Total annual losses of livestock may approach nearly half of the total annual production. Animal diseases and parasites are a major cause of these losses. But we are nowhere near the idealistic situation of disease- and parasite-free animals and we will not be in the foreseeable future.

Research provides the information necessary for detecting and combatting animal diseases and parasites. The present levels of animal production could not have been attained without the application of disease control methods obtained through research. Herein lies an important and self-evident point. Research is not an end in itself. To be of benefit to the animal industries, research results must be applied in the field. Acceptance of new disease control principles by the producers is essential to the success of these programs.

There is at present a two-way lag in the animal disease picture: (1) Research has not provided the answers to many of the problems, and (2) many of the available disease prevention and control measures have not been applied to their best advantage.

By the application of preventive and control measures now available, current animal disease losses might be reduced as much as 25 percent. Additional research knowledge on presently recognized diseases might reasonably be expected to reduce losses by 50 percent over the next 20 years. However, the disease situation is not static. New diseases continue to appear. Thus, disease control will depend upon the ability of research to provide the answers to new problems as they arise. It is difficult to predict the impact of animal disease and parasite research on future land and water resources. One might pessimistically envisage situations where we could lose ground in our battle against disease. Or, we might be able only to keep abreast of the situation. More optimistically, and in line with our objectives, we would hope to continue making significant gains against the overall animal disease problem.

The objective of the livestock industry is to meet the demands of an expanding population. Animal disease research will play an essential role in this objective because disease can be a determining factor in potential production. If we postulate a human population increase of 35 percent between now and 1980, it should be possible to meet the demand for animal products without requiring additional land usage, if

animal disease losses are reduced proportionately. Further research "break-throughs" might even make it possible to meet this demand on a reduced acreage.

Death losses are only a part of the overall losses from animal diseases and parasites. A sick animal is an inefficient producer and parasitic diseases are of particular importance to this inefficiency. The control of parasitic disease of livestock would result in a markedly improved efficiency in use of feed by livestock.

The significance of research on animal diseases and parasites cannot be fully appraised without recognizing the close relationship between animal and human health. More than 80 infectious diseases and a large number of parasitic infections are transmissible from animals to man. Any contribution to animal health is inevitably a contribution to human health.

THE ENTOMOLOGY RESEARCH PROGRAM

Cropland

Acreages of Major Crops

Every major crop produced in the United States is attacked by one or more economically important insect pests. Many of these are indigenous, but a number of the most damaging insect species are of foreign origin and accidentally became established here. Insect pests affect growing crops in various ways. Some soil insects injure or destroy the planted seed, thus preventing germination and establishment of crop stands. Some feed on the roots and weaken the plants so they lodge or fail to grow properly. Other insects bore into plant stalks or stems, or into the trunks of trees; some feed on or suck the juices from the foliage, developing seeds, fruits, or other edible plant parts,and thereby reduce both yield and quality. Still other insects cause great damage by aiding in the spread and development of plant diseases, including many economically important viruses, bacteria, and fungi. Research to develop effective practical methods for controlling insect pests is thus essential to permit maximum production per acre of all our major food, feed, and fiber crops.

Development of New Cropland

When a new area of cropland is brought under cultivation, for the first few years there often may be high productivity of a given crop relatively free from major insect damage. Usually, however, after the same crop has been grown in the area for several years, insects already present build up to damaging populations while new ones not previously present may migrate into the area and become a serious deterrent to crop production. Certain insects are the limiting factor that prevents the commercial production of a given crop on otherwise suitable newly developed cropland. For example, when the Columbia Basin area in Washington came under cultivation several years ago, attempts were made to establish tomato canning factories in the area because it appeared to be highly suited to tomato production. It was soon found, however, that the presence of the beet leafhopper, the only known vector of the deadly curly top disease, made commercial production of tomatoes in the Columbia Basin impractical. Research to develop effective methods of insect control is therefore highly essential to the development of new cropland.

Pasture and Range

The biological control of weeds, through the importation, release, and establishment of insect enemies of weeds, has been shown to be an economical and effective method for developing and improving rangeland. By 1944, an estimated 5,528,000 acres of rangeland in five western States--California, Oregon, Washington, Idaho, and Montana--had become infested with Klamath weed, a native of Europe. This weed competed with forage plants and also adversely affected the grazing animals that ate it. Two species of leaf-feeding beetles, imported from Europe, were released in the weed-infested areas in California and neighboring States, beginning in 1946. As a result of the activity of these bee les, approximately 5 million acres have been returned to useful range with greatly improved livestock-carrying capacity. The success of this method with the Klamath weed indicated that application of the biological approach for the control of other important weeds on rangelands is possible. Control of halogeton, tansy ragwort, Russian thistle, goatgrass, and Medusa head would provide an economical and self-perpetuating way to restore to production many thousand additional acres of weed-infested rangeland in the West. Many such areas are too extensive or too inaccessible for weed control by chemical or other types of treatment.

About 20 species of grasshoppers annually consume large quantities of forage that would otherwise support valuable livestock on many million acres of rangeland in the West. Even under conditions of light infestation, with an average of 6 or 7 grasshoppers to the square yard of range, the insects on 10 acres would consume grass equivalent to the rate for a cow. As more effective, economical, and practical methods of controlling grasshoppers become available through research, the productivity of these rangelands will be greatly improved.

Crop Yields

The development of more effective ways to control injurious insects and of ways to make more efficient use of pollinating insects has a tremendous impact upon increased crop production per acre. While up-to-date figures are not available in most instances, the examples cited will give some indication as to how the production per acre of many crops may be incrased through research.

In 1960, the European corn borer destroyed an estimated 102,991,000 bushels--more than 3 million tons--of corn in 17 States where the bulk of the Nation's grain corn is grown. This was about 2.6 percent of the total U. S. crop. Each borer found in a corn plant is estimated to cut the production of that plant by three percent. The development of chemical corn borer control methods has

greatly reduced losses due to this insect. Data from experimental and demonstration plots in Iowa indicate that a 10-percent increase in yield results from insecticide applications. Thus, Iowa farmers increase their corn production by about 8 million bushels a year through the use of insecticides to control the corn borer. Losses due to this insect are also reduced by growing corn hybrids resistant or tolerant to its attack. The new improved hybrids now available to the grower are capable of reducing these losses by as much as 50 percent. For the year 1960, this reduction would amount to more than 50 million bushels.

Within a few years after the tomato pinworm was first observed in southern California in 1922, it had spread to most of the fields in that commercial tomato growing area and was infesting 60 to 80 percent of the crop. Since growers adopted the cultural and insecticidal control methods developed by research, that insect pest has been reduced to only minor importance.

Wireworms, the soil-inhabiting larvae of click beetles, are serious pests. Unless controlled, they severely limit the production of many crops such as beans, potatoes, sugar beets, onions, lettuce, corn, and melons. They feed on the seeds, seedlings, tubers, bulbs, and plant roots. They occur in all parts of the country, but are especially damaging to crops grown in irrigated areas of the West. Growers formerly could combat wireworms only with cultural controls that depended on the regulation of soil moisture and the rotation of crops, or with very expensive soil fumigants. When DDT became avilable for agricultural use, it was soon found to be highly effective against wireworms when applied to the soil. Estimates from Ventura County, California, in 1948 showed that, when DDT was applied to the soil of 6,600 acres planted to beans, an average increased yield of more than 400 pounds of beans per acre resulted. Other materials have since been found effective and are now widely used to control wireworms.

A material increase in the average productive life of peach orchards, by effective control of the peach tree borer, was made possible by ARS research. The borers feed at or below the ground line on the living wood of peach trees of all ages. Borers, when abundant, may girdle and kill a tree within a year or two. Less severerly infested trees are weakened and become subject to attack by bark beetles and diseases. For many years the only control method available to growers was the tedious process of digging the borers out of the trees by hand. This often caused damage to the trees. Research first developed a practical control method involving the application of paradichlorobenzene crystals around the base of the tree and subsequently a safer and easier method of applying emulsions of ethylene dichloride to the soil about the base of the tree. More recently, effective control has also been obtained by

spraying the trunks of the trees with some of the newer insecticides, such as parathion or Guthion. Growers promptly adopted these methods of borer control. Using them, together with proper fertilization, soil management, and pruning practices, growers have lengthened the profitable life of their orchards by as much as 50 percent. It has been conservatively estimated that effective control of the borers adds at least 25 percent to the annual productiveness of a peach orchard.

Development, through research, and use of a survey method to predict outbreaks of the potato psyllid prevents major losses to potatoes and tomatoes in Colorado, Utah, Wyoming, Montana, and Nebraska. Outbreaks of this insect have occurred periodically since 1911. By the time injury shows up on potato and tomato plants, it is too late to apply effective control measures. Studies of the insect and its development showed that outbreaks in the affected States stem from breeding grounds of the psyllid in the Southwest. It was demonstrated that by making field surveys of psyllid populations along their route of northward movement and correlating these surveys with prevailing weather conditions and the development of host plants, entomologists can anticipate approaching outbreaks in time to forewarn potato and tomato growers to apply insecticides for control. It is conservatively estimated that, in the outbreak year of 1949, use of this survey method saved the yield of potatoes on at least 30 percent of the affected acreage. A saving of 10 million bushels was made possible by the timely application of insecticides.

In addition to the potato psyllid, the potato crop is attacked by a large number of insects, the more important ones of widespread occurrence being several species of aphids, wireworms, leafhoppers, the Colorado potato beetle, flea beetles, and grasshoppers. Aphids and leafhoppers transmit potato diseases that often cause more damage than the direct feeding injury. Losses due to potato insects have materially decreased since DDT and other new insecticides became available. Estimates have shown that, prior to the use of some of these new insecticides in 1946, the average potato production in the United States was about 160 bushels per acre. By 1950, the average production had increased to about 240 bushels per acre. Much of this increase can be attributed to more effective control of potato insects. Prior to 1946, losses of potatoes in Maine due to direct damage by four species of aphids were demonstrated in experimental plots by increases in yield of 20 to 73 percent in plots treated with rotenone or DDT as compared to untreated plots. When DDT came into general use, the per-acre yield of potatoes in Maine increased to 405 bushels for the periods 1946-1952, as compared with 277 bushels for 1936-1945.

At least 50 agricultural crops depend upon honeybees for pollination or yield more abundantly when bees are plentiful. The following are examples of increased crop production obtained by the use of honeybee pollinators. Experiments by State workers in Minnesota in 1957 showed yields as high as 1,400 pounds of sweet clover seed per acre where honeybee colonies were placed in or adjacent to the fields and as low as 6 pounds of seed per acre in cages without bees. Other tests in Minnesota under commercial conditions have shown the increase of sweet clover seed to range from 455 pounds per acre with bees to 63 pounds per acre without bees. Workers in Georgia in 1954 obtained yields of 491 pounds of crimson clover seed per acre when bees were used as pollinators as compared to 130 pounds of seed in cages from which bees were excluded. ARS scientists in Louisiana in 1960 obtained yields of 387 pounds of white clover seed in fields with honeybee colonies as compared to 267 pounds per acre in fields without honeybee colonies. Yields of cranberries in Wisconsin have been raised from 124 barrels per acre to 160 barrels per acre by the use of honeybees. In 1947, workers in Michigan reported an astounding increase from 18 to 1,000 bushels of pears after introduction of honeybees to an individual orchard. Research is continuing to develop improved methods for the increased production of various crops through the use of honeybees and other pollinating insects.

Improvement of Efficiency of Livestock Use of Feed

Insect pests of forage crops and the diseases that some of them transmit cause enormous waste in quality as well as quantity of potentially good hay crops. The potato leafhopper sucks the juices from alfalfa plants, causing the foliage to yellow and develop poorly. Chemical analysis of leafhopper-damaged alfalfa hay showed a more than normal proportion of carbohydrates, less protein than normal, and only half the carotene found in normally green and leafy hay. Similarly, the loss of leaves due to attack by the spotted alfalfa aphid reduces the protein and carotene content of the hay. Such hay also has a lower feeding value and palatability as it is stemmy and contains large amounts of sotty mold that grows in the honeydew deposited on the plants by the aphids. The use of insecticides, natural enemies, and alfalfa varieties resistant to the potato leafhopper and the spotted alfalfa aphid is helping prevent the reduction in nutritive value caused by these insect pests.

Improved Practices

Various kinds of insecticides and formulations applied to seed, soil, and the foliage of plants are of tremendous importance in protecting all kinds of agricultural crops from insect damage and in thus increasing the yield and quality of the crops. One of the best long-range approaches to insect control, however, is the development of improved varieties of crops resistant to attack or damage by specific insect pests. Considerable success has already been achieved in the development of alfalfa varieties resistant to the spotted alfalfa aphid, wheat varieties resistant to the Hessian fly and wheat stem sawfly, corn varieties resistant to the European corn borer and the corn earworm, and sugarcane varieties resistant to the sugarcane borer. Relatively little research attention has as yet been given to the development of vegetable varieties resistant to insects. Prevention of insect damage appears to be a logical long-range approach for increasing the yield and quality of many commercially important vegetable crops. The same principle applies to research on other major crops such as cotton and sugar beets.

ECONOMIC RESEARCH SERVICE

Agricultural economics research comprises a broad program of economic analysis of factors affecting agricultural prices and income, commodity outlook and situation, food demand, consumption, and production. The relationships between the farm economy and the national economy are studied, as are the economic forces affecting general levels of demand, supply, prices, and incomes in agriculture. Important segments of the research program are concerned with population, farm labor, levels of living, rural development, agricultural adjustment, and land and water problems. This research provides useful information on the economic status of farmers, the relation of farm income to nonfarm income, the outlook for agriculture generally, and the long-run requirements and potentials for land and water resources. Farmers and others are provided with essential information to help them understand conditions affecting farm people and the agricultural economy and to adjust to pressures from economic forces affecting prices, supply, and consumption of agricultural products.

The national program of economic and statistical research on farm production problems administered by the Economic Research Service involves studies concerned with the efficient use of labor, land, water, and equipment in farm production; resource ownership and control; and adjustments in farming to technological development and changing market outlets. Included is research on production, income, and costs involving appraisals of farm output and productivity; studies of costs and returns on important types of farms; research on rural development problems involving studies of low-production farms and their opportunities for income improvement; and research in agricultural finance, dealing with farm credit, agricultural risk and insurance problems, and taxation. Although some phases of these areas of economic research are related to land and water resource policy, two areas having the most direct bearing are research on farming adjustments and research on land and water resources.

Research on the problems of agricultural adjustment and supply response are concerned with the achievement of economic balance in agriculture under conditions that provide adequate returns to farmers. Within the framework of likely and needed national and regional aggregative production response, evaluations are made of the adjustments that would be profitable to individual farmers under alternative farm adjustment programs. Activities include the assembly of information and analysis of national and regional agricultural productivity, production response in relation to adjustment needs, profitable adjustments to changing market conditions in major farming areas, and the impact and adequacy of various Government supply-management programs.

Land and water research involves studies of the economic use and development of land and water resources, land income and values, resource institutions, and land tenure problems. Such studies include periodic inventories of land and water resource uses, research on the economics of land and water resource management, analysis of competing uses and changes in patterns of use over time, and appraisals of resource development potentials in relation to economic growth and projected requirements. Also included are analyses of the adequacy and effectiveness of laws, administrative measures, and organizational arrangements for directing the use and management of land and water resources; and analyses of the effects on resource use of methods for acquiring and transferring ownership, contractual operating arrangements, and the division and distribution of property rights in land and water resources.

FORESTRY RESEARCH

Federal forestry research is the responsibility of the Forest Service and directly accounts for a large share of the total forestry research effort. The Forest Service program is organized around ten regional forest and range experiment stations and the Forest Products Laboratory. Much of its research is done cooperatively with State experiment stations, universities, forest and rangeland owners, and wood-using industries.

Research is Basic for Effective Forest Use

The impact of technology on resource requirements and potentials is expressed in several ways. Change can be induced by increasing productivity of the land, by reducing losses from waste and damage, by improving the product, by developing new uses and new markets for the product, and by reducing the cost of any stage in its production, harvesting, and marketing. The contributions from forestry research can usually be readily identified, but quantitative measurement of their effect is difficult. The objective of forestry research is to acquire knowledge and understanding of the character and relationships of forest soil and water, and to apply this knowledge in the development of better methods of protecting, managing, and using all the forest resources.

The Nation's forests will be hard-pressed to meet steadily rising requirements of all kinds in the years ahead. Heavy reliance upon research will be needed to assure adequate supplies of forest products to meet these requirements. The major products and benefits of the forest are timber, water, forage for livestock, wildlife, and recreational opportunities. All of these values can be enhanced by scientific management of forest and forest land if based upon a solid foundation of research.

Forest Management Research Shapes the Timber Economy

In the field of forest management, research is concerned with the improvement of quality and quantity of timber production through the development of intensive cultural measures and through the genetic development of improved strains of trees. Of major importance is research leading to the conversion of nonproductive land to forest cover. For example, studies involving diagnosis of soil and site conditions in relation to tree seedling survival and growth has resulted in the development of techniques for successful establishment of forest cover on strip-mined "spoilbanks" in the central States.

A major forestry effort in each of the past two years has been the planting or seeding of more than 2 million acres. Much of this area consisted of old fields, burns, cutovers, and other land suffering from abuse or neglect. The success of this reforestation effort, and of earlier ones, can be directly attributed to research findings. The more than 2 billion forest tree seedlings produced in the last two years could not have been grown without the successful solution of many forest nursery disease problems. Knowledge of how to treat and disperse seed so that it will survive both the attacks of birds and rodents and the adverse conditions of the site have led to direct seeding techniques which now permit reestablishment of forest cover on inaccessible or otherwise unplantable areas.

Research Strengthens Forage, Wildlife, and Recreation Values

On the vast areas of forest and open rangelands, principally in the West and in the South, a major problem for research is to appraise the effects of grazing on soil and range vegetation as a basis for estimating livestock carrying capacity and developing appropriate systems of range livestock management. Research in this field also calls for basic study of soils and other aspects of the plant environment. The field of wildlife habitat research is closely related. It is concerned with a similar set of problems that pertain to successful management of game habitat for optimum food and shelter. Artificial regeneration of many deteriorated big game ranges in the West is now feasible. Intensive research has lead to the selection of a few desirable food and cover species that can be successfully established.

The program of research in forest recreation is of more recent origin. The benefits provided by the forest, and its associated lakes and streams, for the various kinds of recreational enjoyment can be multiplied many times when suitable areas for recreational activities are properly selected, developed, protected, and managed. In order to anticipate and meet the requirements of the people who use the forests, determination of their preferences, needs, and attitudes is of major importance.

Scientific Management of Forested Watersheds

The relationship of forests to water supply is well recognized but not fully understood. Research in watershed management has several major objectives. One is to learn how to revegetate and stabilize denuded forest areas that are sources of sediment and flood runoff. Others are to improve the hydrological conditions of sites and to increase water yields by manipulation of the vegetative cover.

Research has led to the development of methods for rehabilitating seriously eroded and critical watershed areas. For example, the technique of terracing and planting in the Wasatch Mountains of Utah has successfully stopped the destructive mud flows which had been menacing land and homes in the valleys. The headwaters of many major streams lie in the high precipitation zone of the southern Appalachians. In this critical watershed region, 20 years of research at the Coweeta Hydrologic Laboratory in North Carolina have shown conclusively that conversion of hardwood forest to low-growing vegetation can increase stream flow substantially.

The study of soil properties, and also study of the inter-relationships and conflicts associated with various uses, is typical of the broad fields of forestry research that cut across functional lines.

Protection from Fire, Insects, and Disease

The three principal sources of damage and loss to the forest and its associated products and values are fire, insects, and disease. Fire destroys timber, forage, and browse. It also creates conditions which lead to erosion, floods, and general deterioration of the sites. The prevention of fires is of paramount importance. Forest Service scientists are leaders in trying to reduce man-caused fires through programs of better education techniques, law enforcement procedures, and inducements for public cooperation. Basic research in atmospheric physics and meteorology is designed to provide leads on how to prevent or reduce the fire-starting potential of lightning storms.

The need to anticipate and prepare for periods of high hazard led to early study of "fire weather." The fire danger meter, first developed in the 1930's, is a device that measures and evaluates key weather factors. It has been improved and adapted over the years and is now used by virtually all forest protection agencies in the country. Modern methods of attack on fire have developed from research--the smokejumper and the steerable parachute, the helicopter to lay hose lines in rough country, and the chemical fire retardants applied from the air are examples. Supporting and supplementing this research have been fundamental studies relating to fire behavior. These have led to much more efficient planning and organization of fire suppression activities.

Complete knowledge of the biology and ecology of major forest insect pests is necessary for effective control. Of particular concern is the need to identify and analyze unique insect problems resulting from the new environment created by intensive forest culture. Research is taking advantage of modern knowledge and techniques in developing new control systems utilizing irradiation, hormones, cross-breeding, and various kinds of chemicals as well as biological control methods.

Substantial reduction of losses inflicted on the timber resources by insects has been achieved. Research has shown that much can be accomplished through preventive methods. For example, in the case of bark beetles in California, research showed how to anticipate attack on ponderosa pine; by well-timed harvest, large volumes of timber that would otherwise be lost can be saved. An outstanding example of biological control is the use of a spray, compounded from a virus organism deadly to European sawfly, to prevent damage by this insect to red pine plantations.

In another field of forest protection, research is disclosing the identity, life history, nature of damage, and host relations of major forest diseases. The understanding and use of genetic resistance to protect important timber species from disease attacks is expanding, as is our fundamental knowledge of the use of antibiotics. Non-infectious agents such as climatic extremes and noxious fumes destructive to forest trees are also being studied.

As an example of progress, recent research findings have shown that antibiotics can completely arrest white pine blister rust in infected pine if the attack is not too far advanced. Intensive study of the requirements of this same disease organism has shown also that, because of certain unique conditions of microclimate, the rust hazard in some areas is so low that white pine can be safely grown without the need for expensive control measures.

The impact of fire, insects, and disease upon timber inventories and growth is staggering. Research in forest protection offers one of the best ways to improve the timber supply situation and at the same time significantly benefit other major uses.

Research Advances the Use of Wood

An important mission of forest products research is to learn how to lengthen the service life of wood by developing better seasoning and drying practices and more effective chemical preservatives. This would indirectly reduce timber requirements. Improvement and expansion of the use of wood in structures and packaging, through more complete understanding of design factors, wood properties, and fabrication techniques, are also products of research.

Resource potentials are increased by finding uses for previously unmarketable timber species. An example of this is the development of the cold soda and semichemical pulping processes at our Forest Products Laboratory. By these processes, previously unmarketable low-value hardwoods can be converted into paper and thereby reduce the pressure on the more valuable species. The semichemical pulp process is now used by 37 mills producing over 1.5 million tons of pulp annually. The cold soda process, developed in 1953, is now being used by 9 companies producing more than 287,000 tons of pulp annually. In the Northwest, literally billions of board feet of large, old-growth Douglas fir timber have been considered practically worthless because of their infection with a rot locally called "white pocket." Research has demonstrated that veneer and plywood of satisfactory grade can be made from this white pocket material, and it is now possible to use large quantities of Douglas fir that was formerly unmerchantable.

Another relatively new field of research is that of forest engineering. Here the objective is to learn how to mechanize forestry operations to meet the needs of modern intensive forestry. New and better systems for constructing roads and removing timber from difficult areas, especially from steep, unstable slopes on critical western watersheds, need to be developed and evaluated. Special equipment must be designed to permit practical harvesting of small, low-value timber in the rough mountainous terrain of the East. New principles and systems for overland transport of wood, especially in chip form, need intensive study.

Economics of Forestry Requires Evaluation

An essential element to virtually all aspects of forestry is the nationwide forest survey. This is a continuing project which maintains a basic inventory of area, volume, condition, and distribution of forest resources. The survey also determines cut trends for industrial and other products, and appraises the probable future availability of timber supplies. Except for portions of Alaska, most of the 773 million acres of forest has now been inventoried at least once.

A major function of research in forest economics is to determine levels of economic returns to be expected from varying intensities of forestry practice. The influence of various factors such as markets, labor, topography, and site quality upon the profitability of forestry is of particular interest with respect to farm and other small private holdings. Of growing importance is the need to formulate concepts, principles, and procedures for economic evaluation of alternative combinations of forest land use, and to develop guides for making management decisions.

The field of forest marketing research includes studies to find new outlets for low-grade forest products. New and better ways of organizing timber harvesting and transportation operations from stump to market--especially on small ownerships--need to be conceived, designed, and tested. The identification of competitive factors limiting broader use of wood products and determination of how to use the wood supply more fully and effectively form an important part of this program. Trends in consumption of various classes of wood products are evaluated and translated into estimates of future requirements. Periodic appraisals of the adequacy of timber supplies to meet future needs are made.

A concerted effort in marketing research has recently brought about a greatly increased use of formerly wasted wood material. In the South, surveys were conducted of the amount and location of sawmill residue suitable for conversion to chips for pulpmills. Studies were made of marketing costs and values, and appraisals of methods and equipment needed for salvaging this material were conducted. The result has been a rise in the use of southern pine residues for pulp from practically nothing in 1953 to 3 million cords in 1960.

Strengthened Forestry Research is Needed

Under the pressure of increased demands upon the land for more use and greater productivity, the level of scientific management applied to it will of necessity rise steadily. But forest owners, stockmen, public forest managers, and wood using industries must rely upon a stronger foundation of research results to support their intensified efforts. In the future, research in forest protection, forest management, utilization of the multiple forest products, and benefits from forest and range will intensify as well as expand. More concentration upon fundamental biological and physical laws and upon underlying cause-effect relationships will be required. Only in this way can the essential storehouse of scientific knowledge be continually replenished.